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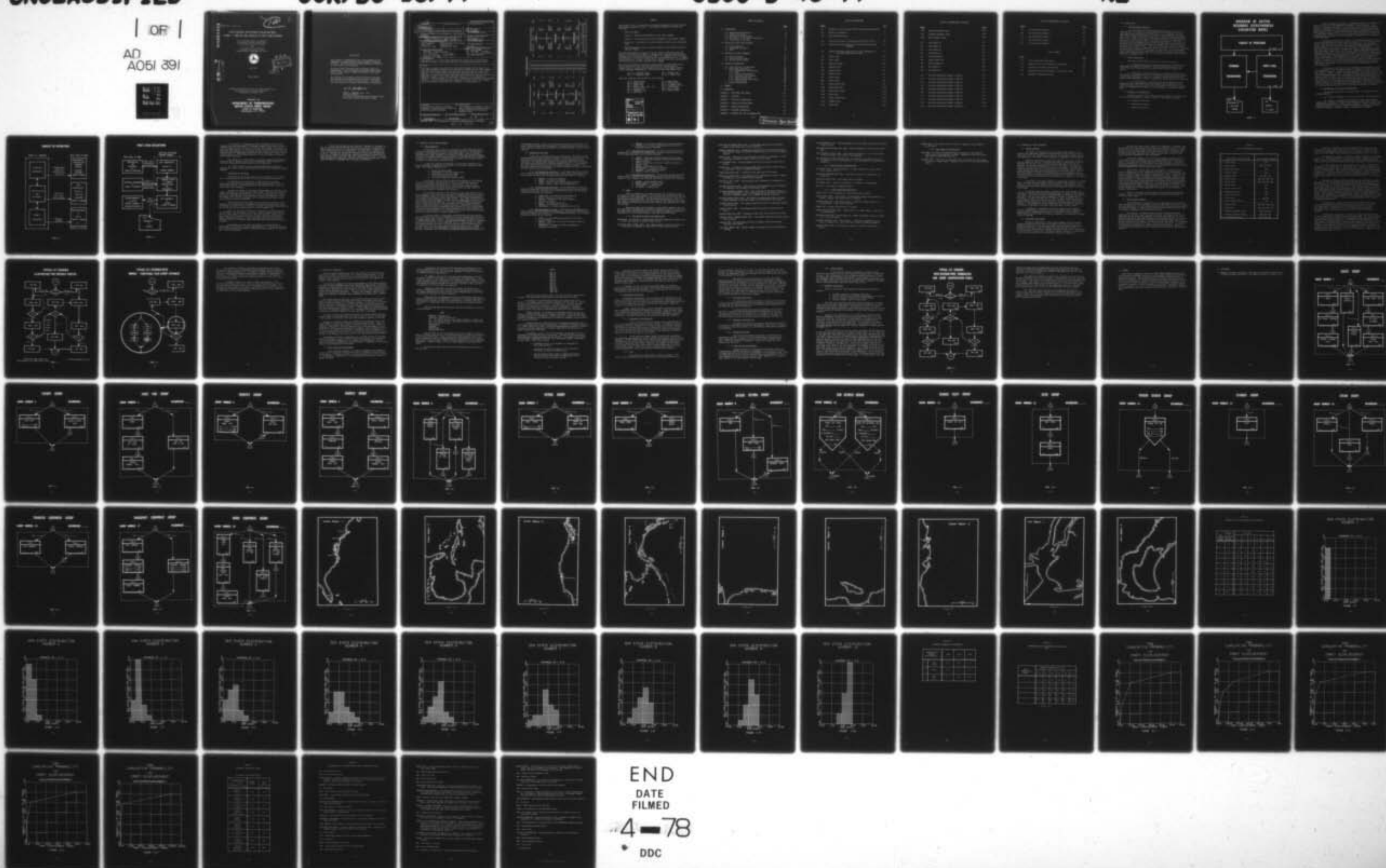

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CUTTER RESOURCE EFFECTIVENESS EVALUATION MODEL
VOLUME I - ANALYSIS AND SYNTHESIS OF COAST GUARD PROGRAMS

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June 1977

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Washington, D.C. 20590

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This report is one of series which documents the Cutter Resource Effectiveness Evaluation Project at the CG R&D Center and the Transportation Systems Center.

16. Abstract

This report documents the analysis of Coast Guard Programs and the logic of the structured synthesis necessary to obtain useable scenarios for the Cutter Resource Effectiveness Evaluation Model which evaluates craft performance in Coast Guard missions. This volume contains the necessary information for the users of the CREE Model to realistically model their particular operational area in a flow chart formatted scenario so that craft performance evaluation can be subsequently conducted. Detailed listing of a spectrum of operational requirements are presented as well as a typical sample scenario. Subsequent volumes of this series address the actual evaluation procedure and utilization of the CREE Model.

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METRIC CONVERSION FACTORS

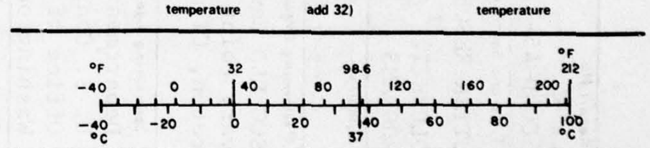
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



PREFACE

This volume is one of a series which collectively documents the Cutter Resource Effectiveness Evaluation Project. The complete documentation includes the following:

- Executive Summary
- Volume I: Analysis and Synthesis of Coast Guard Programs
- Volume II: The Evaluation of Craft Performance in Coast Guard Programs
- Volume III: Utilization of the Cutter Resource Effectiveness Evaluation Model
- Users/Programmers Guide to the Cutter Resource Effectiveness Evaluation Computer Program

The study was requested in August 1974 by the Office of Operations and until August 1975 was directed by CAPT C. L. BLAHA, Chief, Plans and Programs Staff. Subsequent efforts have been directed by CAPT P. M. JACOBSEN, Chief, Plans and Programs Staff. The initial Project Monitor in G-OP staff was Mr. P. J. D'ZMURA. Since October 1975, LCDR B. C. MILLER of the G-OP staff has been Project Monitor. The Project Office in G-DOE-2 has been CDR A. TURNER.

This study was conducted by the Coast Guard Research and Development Center, Groton, Connecticut, with technical assistance from the Department of Transportation's research and development activity, Transportation Systems Center, Cambridge, Massachusetts. The full-time study team members were:

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1.0 INTRODUCTION

1.1 Administrative Background

The Cutter Resource Effectiveness Evaluation Project was initially concerned with the rather well-defined objective of determining the type of craft which should replace the aging WPB fleet, with an emphasis upon using HPWC (High Performance Watercraft) in the mix of craft selected to replace the patrol boats. Later, the Office of Operations redirected the "WPB Replacement Project" to include a much broader consideration of HPWC to determine the potential for utilization of HPWC in all Coast Guard missions. The thesis for this redirection and expansion in the study was that HPWC could improve Coast Guard mission performance in some areas, yet would be less effective than conventional craft in other areas. Later, after considerable problem definition, a project title change, and planning by personnel in both the Office of Operations and the Office of Research and Development, an approach to the investigation of the suitability of HPWC in Coast Guard missions was developed and a Specific Administrative/Planning Requirement for the project was issued by the Office of Operations in January 1976.

1.2 Project Objectives

The Specific Requirement contained the following objectives:

a. To determine the mission-related capabilities, limitations, and operational and support requirements of high performance watercraft and of conventional Coast Guard vessels (with and without aircraft), present and future.

b. To develop a method which provides a quantitative description of the costs and effectiveness of HPWC and conventional vessels and which presents a quantitative evaluation of the craft considered in task, program and multi-program mission performance, singly, comparatively and within a mix of resources.

c. As an end product, to provide the Office of Operations with a theoretical model, implementing computer programs, and documentation which satisfy the above objectives, with sufficient flexibility so that the user may tailor the computational procedures to his operational or analytical requirements.

1.3 Overview of the CREE Model

The Cutter Resource Effectiveness Evaluation Model is presently made up of three major elements as shown in Figure 1-1 and listed as follows:

a. Concepts of Operations

b. Craft/Task Evaluations

c. Scenario Calculations

OVERVIEW OF CUTTER RESOURCE EFFECTIVENESS EVALUATION MODEL

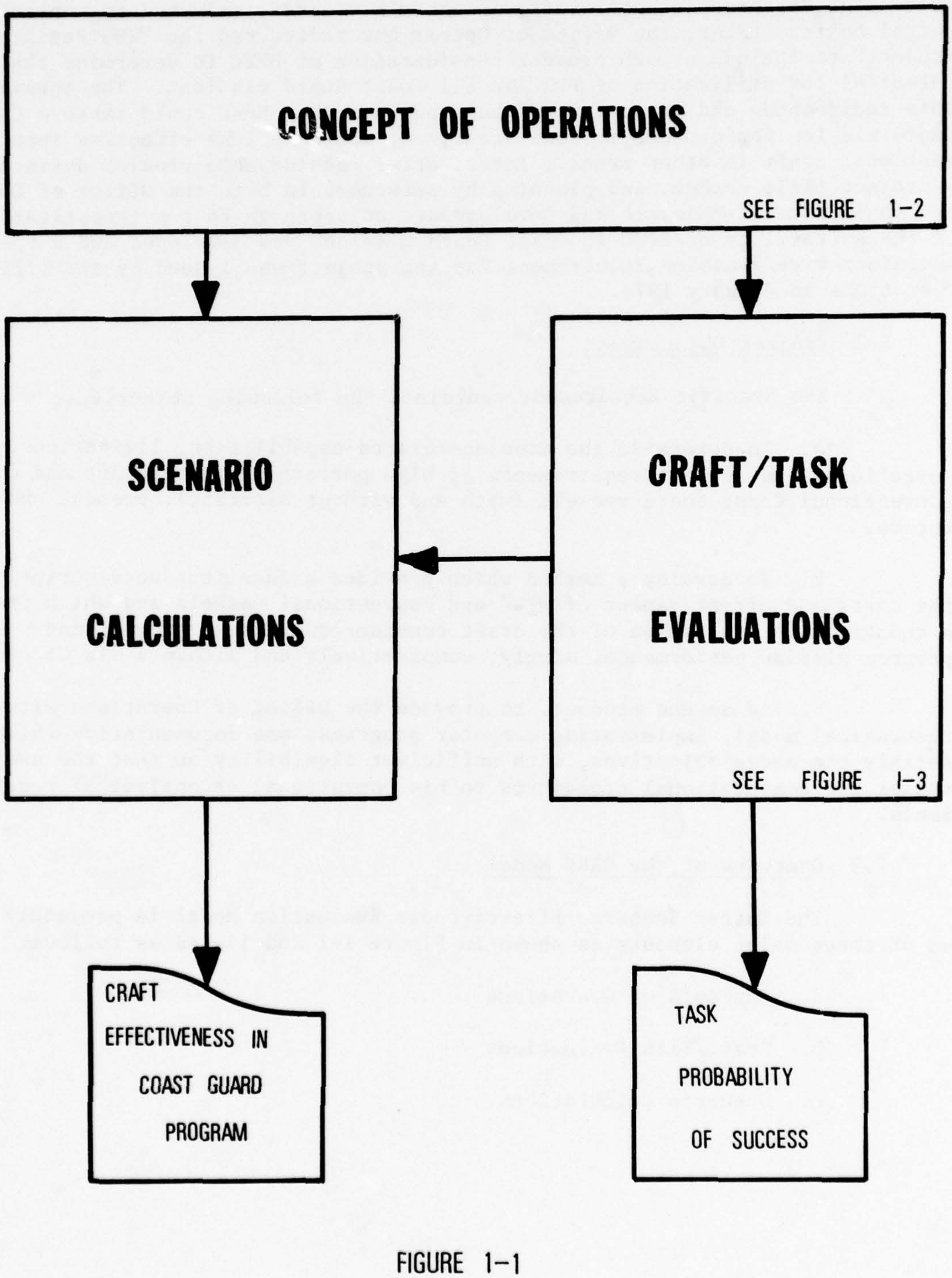


FIGURE 1-1

Broadly speaking, the Concepts of Operations element is concerned with modeling the job to be performed and the method of craft deployment. This is where operational requirements are specified, various craft and suitable methods of deployment are chosen, and task-oriented scenarios are constructed. Concepts of Operations is the starting point for use of the CREE Model and has been organized in such a fashion that the user has great flexibility in choice of requirements, selection of craft and construction of scenarios. Figure 1-2 illustrates the information flow from Concepts of Operations to other portions of the CREE Model.

The Craft/Task Evaluation element of the CREE Model consists of three sections which eventually provide a numerical evaluation of craft performance of a task. The first section, called Craft Characteristics, takes the craft concept specified in the Concept of Operations and determines typical detailed characteristics of that craft. The second section, called Parameter uses these Craft Characteristics coupled with various operational requirements from the Concept of Operations, to calculate dimensionless numerical values (parameters) indicative of the craft's performance in a variety of areas, such as maneuverability at various operational speeds, towing ability, and seakindliness, to cite a few. These Parameters form the input for the third section, called Task Probability of Success, which calculates craft performance in a task. The outputs of the Craft/Task Evaluations element are numerical values indicative of how a given craft performs the given tasks with the specified operational requirements. Figure 1-3 illustrates the organization of Craft/Task Evaluations.

The Scenario Calculations element addresses the performance of craft in a larger arena - that of complete sorties or missions, in either single or multi-program scenarios. Because scenarios are made up of tasks, like search, tow, board or transit, and since craft performance of tasks is quantified in the Craft/Task Effectiveness output, the Scenario Calculations element utilizes this output as shown in Figure 1-1. In addition to these values, the frequency of task occurrence is also considered in evaluating overall craft performance in the scenario. The calculations incorporating the Task Probability of Success, and the frequency of task occurrence are accomplished by the Program Probability of Success element of the CREE computer program, which has as its output, values for craft mission effectiveness for the specified operational requirements.

1.4 The Contents of the Study Documentation

The theoretical aspects of the CREE Project are documented in the following volumes:

(a) "Executive Summary" is a concise overview of the CREE Project.

(b) Volume I - "Analysis and Synthesis of Coast Guard Programs" addresses the analysis of the Coast Guard Programs and the logic of the structured synthesis necessary to obtain usable scenarios. Volume I describes the modeling procedure followed and contains the detailed information necessary to construct scenarios. A simple scenario is presented as an example.

CONCEPT OF OPERATIONS

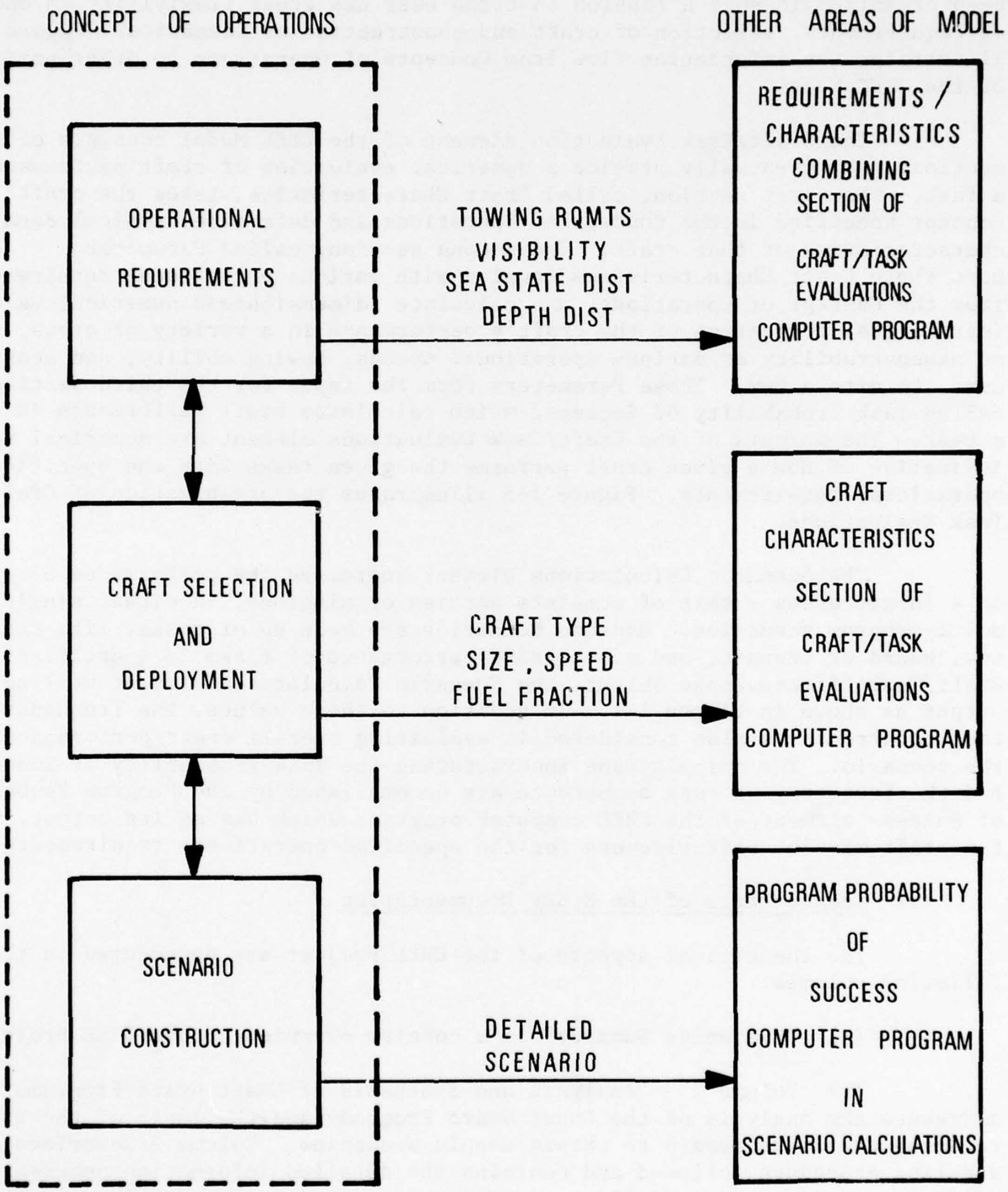


FIGURE 1–2

CRAFT/TASK EVALUATIONS

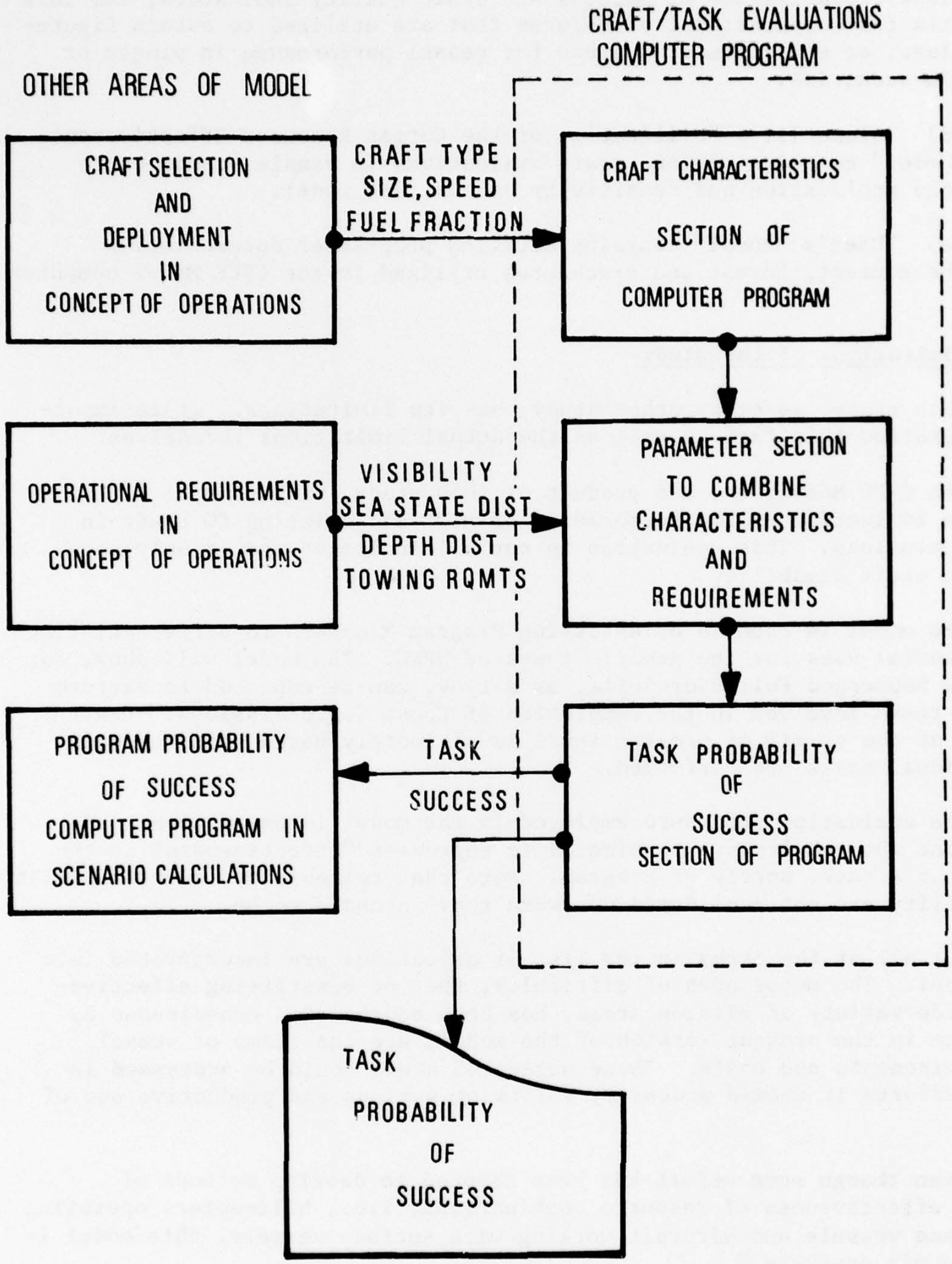


FIGURE 1-3

(c) Volume II - "Evaluation of Craft Performance in Coast Guard Programs" explains and documents the computer program that provides the typical characteristics and capabilities of the various types of HPWC, conventional, and Coast Guard vessels. It describes the logic and presents the procedure for developing Task Probabilities of Success and other quality indicators; and this volume details the computational procedures that are utilized to obtain figure-of-merit values, or effectiveness values for vessel performance in single or multi-program scenarios.

(d) Volume III - "Utilization of the Cutter Resource Effectiveness Evaluation Model" contains various craft evaluations in sample scenarios to illustrate the application and sensitivity of the CREE model.

(e) "User's Manual" contains detailed programmer documentation regarding the content, format and procedures utilized in the CREE Model computer programs.

1.5 Limitations of the Study

This study, as every other study, has its limitations. It is important to understand this fact as well as the actual limitations themselves.

The CREE Model, the end product of this study, will provide a quantitative evaluation of the performance of HPWC and existing CG craft in Coast Guard missions. This evaluation is not all inclusive and it only considers basic craft capability.

The model is capable of assisting Program Managers in differentiating between potential uses for the generic types of HPWC. The model will show, for example, how Submerged Foil Hydrofoils, as a type, can be expected to perform the various tasks involved in the completion of Coast Guard missions. Craft Performance at the sortie or program level is ultimately based upon how well these individual tasks are performed.

The evaluation procedure employed in the model is based upon craft capability and the results are considered to represent "effectiveness" in the performance of a task, sortie or Program. Note that reliability, maintainability, and availability are not considered nor were they intended to be.

Not all of the items in the list of objectives are incorporated into the CREE Model. The major area of difficulty, that of quantifying effectiveness in a wide variety of mission areas, has been addressed. Conspicuous by their absence in the present version of the model, are the items of vessel support requirements and costs. These neglected areas could be addressed in subsequent efforts if deemed necessary following serious and productive use of the model.

Even though some effort has been devoted to develop methods of quantifying effectiveness of resource combinations, i.e., helicopters operating off of surface vessels and aircraft working with surface vessels, this model is not a "force mix analysis."

Finally, and perhaps the most important limitation of the model, is that it was conceived and developed specifically to provide an assessment of High Performance Watercraft, though during the development, a capability to assess existing CG craft was incorporated. The model is not a panacea, and is not all inclusive nor necessarily extendable to other problems requiring solutions. Although the methodology conceived may possibly be applicable to other similar types of problems, this model generally will not be. It simply addresses HPWC and conventional resources in Coast Guard missions only to the extent necessary to highlight their performance differences.

2.0 ANALYSIS OF COAST GUARD PROGRAMS

2.1 General Approach

To determine the potential for utilization of HPWC (High Performance Watercraft) and conventional craft in Coast Guard missions, it is first of all necessary to understand the missions of the Coast Guard. Given an in-depth understanding of these missions, it is possible to model the sequence of events necessary to accomplish these missions so that craft performance can be evaluated. Evaluation of various craft in these modeled activities will illustrate their potential for utilization in the Coast Guard.

To gain the in-depth understanding of the specific missions of the Coast Guard under consideration, an analysis of Coast Guard Programs was undertaken. The Programs considered were:

a. Search and Rescue (SAR)
b. Enforcement of Laws and Treaties (ELT)
c. Marine Science Activities (MSA)
d. Port Safety and Security (PSS)
e. Marine Environmental Protection (MEP)

Specifically, this analysis included the disassembly of the Programs into their constituent elements or parts in order to determine the nature, function, relationship, and importance of these elements. Two levels of Program components were identified in the course of the analysis, Program Operational Activities and Program Tasks, both of which are used in the subsequent restructuring or synthesis into scenarios.

The procedure utilized in the analysis of Coast Guard Missions was to first examine the Coast Guard Objectives and the Program Objectives as listed in the PLAN SUMMARY document to gain a preliminary understanding and appreciation of the magnitude and scope of Coast Guard affairs. The Program Sub-Objectives, also listed in the PLAN SUMMARY, provided further insight and more specific information regarding Program endeavors. Also from the PLAN SUMMARY, Program Goals, listed as near-term, mid-term, and long range, assisted in identifying those areas of needed improvement in Program performance. Examination and study of these Goals and the listed intermediate steps required for their accomplishment, provided further background for the understanding of Coast Guard missions, and helped in the identification of the activities conducted by Coast Guard personnel and units in their efforts to achieve Program Goals.

To further assist in identifying the operational activities and the tasks performed, and to further understand the various programs under consideration, many sources were utilized. These included Coast Guard publications such as PROGRAM DESCRIPTIONS (CG-380-1) and PROGRAM REQUIREMENTS (CG-380-2), Commandant Instructions and Notices, such as COMDTINST 3120.11, "Establishment of Mission Performance Standards for Units with Port Safety and Marine Environmental Protection Duties," and other Coast Guard-affiliated literature such as ALUMNI BULLETIN, SAR REVIEW and Proceedings of the Merchant Marine Safety Council. In addition, discussions with the cognizant program and planning staff personnel at

the Headquarters level, visits to and conversation with Area and District personnel, plus involvement with and exposure to actual operational missions and fleet personnel furthered the acquisition of detailed knowledge required in this analysis.

2.2 Operational Activities

Operational Activities are the actual missions or functions that are performed by Coast Guard personnel and units. They are not the objectives, but the activities that, when conducted, contribute to the achievement of the objectives. For organizational purposes the following Operational Activities are listed under the particular Program being addressed, but it is important to note that some Operational Activities are common to several Programs. This means that although the objectives of the various Programs may differ, essentially the same physical jobs are performed.

2.2.1 SAR Operational Activities - In the Search and Rescue Program, with its objective of minimizing loss of life, injury and property damage, on, over or under the water, the following Operational Activities are conducted:

a. RESPOND - to cases of emergency
b. SEARCH - to find the distressed
c. RESCUE - those in need from the danger involved
d. ASSIST - those in need to prevent emergencies

2.2.2 ELT Operational Activities - In the Enforcement of Laws and Treaties Program, with its objective of protecting and preserving the national resources and national interests within jurisdictional waters, the following Operational Activities are conducted:

a. GATHER DATA - by surveillance and inspection
b. DETER - potential violators of the law
c. ENFORCE - violations of the law by seizure, detection or arrest
d. DETECT - violations of the law
e. RESPOND - to violations of the law
f. INVESTIGATE - to insure compliance with the law

2.2.3 MEP Operational Activities - In the Marine Environmental Protection Program, with its objective of maintaining, improving and protecting the marine environment from pollution of oil or hazardous substances, the following Operational Activities are conducted:

a. DETECT - oil and hazardous substances in the water by surveillance
b. ENFORCE - violations of the law by seizure, detection, arrest or fine
c. PREVENTION - of damage to marine environment by education and presence

d. RESPOND - to pollution incidents with cleanup equipment
e. INVESTIGATE - to insure compliance with the law or to determine extent of pollution

2.2.4 PSS Operational Activities - In the Port Safety and Security Program, with its objective of safeguarding the nation's ports and waterways, the following Operational Activities are conducted:

a. INSPECT - waterfront facilities and specified vessels
b. MONITOR - liquid bulk transfer operations and hazardous cargo operations
c. DETECT - violations of the law or unsafe practices in the port areas
d. ENFORCE - violations of the law
e. SURVEILLANCE - of vessels of interest
f. TRANSPORT - miscellaneous equipment
g. RESPOND - to port disasters

2.2.5 MSA Operational Activities - In the Marine Science Activities Program, with its objective of improving environmental-related predictions in support of other Programs, the following Operational Activities are conducted:

a. SUPPORT - of environmental buoys
b. WEATHER SURVEYS - to gather data
c. OCEAN SURVEYS - to gather data
d. ICE PATROL - to gather data

2.3 Tasks

Tasks are defined as the lowest discrete level of activity in the performance of Coast Guard missions. They describe the individual actions that are completed in the Operational Activities, and as such are the steps taken to achieve the Program Objectives. Like the Operational Activities, there is a high degree of commonality among the tasks of the various Programs, which means that, despite the objectives of the various Programs, the same physical actions are performed.

Since most tasks are not peculiar to any specific Program, they are more conveniently organized and presented in categories relating to craft speed. The three letter task acronymns used in the computer programs are presented in parenthesis in the following listing of tasks and their definitions.

2.3.1 Slow Speed (On Scene) Task Definitions

BOARD (BRD) - The process of transferring people and lightweight equipment from the CG unit directly to another vessel or pier.

FIGHT FIRE FROM CG VESSEL (FFF) - Fire fighting monitor on board CG vessel is operated by CG personnel to fight fires on other vessels and piers.

FIGHT FIRE ON ANOTHER VESSEL (FFO) - CG personnel fight fire on the subject vessel or pier while the CG vessel stands by.

GENERAL ASSISTANCE (GAS) - Rendering assistance while on board the CG vessel. This includes actions as diverse as passing a gas can or providing communications.

INSPECT (INS) - Inspection of non-CG vessels or piers by CG personnel. Action takes place on subject vessel or pier, not on CG vessel.

LOAD EQUIPMENT (LEQ) - Placing equipment such as an oil boom on board the CG vessel.

LOITER (LOI) - A standby or waiting (ALPHA) status in which no other function is performed. Craft is considered underway.

LAUNCH SMALL BOAT (LSB) - Launching a small boat from the CG vessel.

MONITOR ACTIVITIES (MAC) - The engaging in the observation of events to gather information as to the status of the situation.

MONITOR OIL SPILL (MOS) - The observation and coordination of cleaning up an oil spill.

ON BOARD ASSISTANCE (OBA) - That collection of miscellaneous jobs performed by CG personnel after boarding the distressed vessel.

ON SCENE COMMANDER (GENERAL) (OSC) - That collection of OSC duties which are basically independent of craft type and solely the function of vessel outfit and CG personnel aboard, e.g., *Command and Control functions.*

RETRIEVE BOARDING PARTY (RBP) - The process of transferring people and lightweight equipment from another vessel or pier directly to the CG unit.

RETRIEVE OBJECTS (ROB) - The bringing aboard the CG unit of lightweight objects from the water.

RETRIEVE PEOPLE (RPE) - The bringing aboard the CG unit of people from the water.

RETRIEVE SMALL BOAT (RSB) - Bringing the small boat back aboard the CG vessel.

STAKEOUT SPECIAL INTEREST VESSEL (SSI) - The intense monitoring of these vessels when at anchor.

SEIZURE (SZE) - The enforcement activity of taking a vessel and on-board personnel into custody.

TAKE WATER SAMPLE (TWS) - Taking a sample of the water for future laboratory testing.

UNLOAD EQUIPMENT (ULQ) - Taking equipment off the CG vessel and placing on another vessel or pier.

WORK EQUIPMENT FROM SMALL BOAT (WQB) - Working equipment in the water from ship's MSB.

WORK EQUIPMENT AT DRIFT (WQD) - The working of equipment on or from the CG unit in which position of the vessel is not important.

WORK EQUIPMENT AT FIXED POSITION (WQF) - The working of equipment such as an oil boom that is in a fixed position. This task implies craft maneuvering capability.

2.3.2 Reduced Speed Task Definitions

SLOW ESCORT (SES) - The accompanying of a vessel from point to point, such as with a seizure in ELT.

SEARCH FOR DISTRESSED UNIT (SDU) - The visual search for a small craft. No sensor aid.

SEARCH FOR PEOPLE (SPE) - The visual search for people.

SLOW PATROL (SPT) - General surveillance of a region at a reduced speed.

TOW (TOW) - The towing of disabled vessels.

2.3.3. Cruise Speed Task Definitions

ESCORT (ESC) - The accompanying of a vessel from point to point.

IDENTIFY CRAFT (IDC) - That process of classifying a single craft detected by a search. Implies that visual acuity is required.

IDENTIFY FLEET (IDF) - The identifying of a number of fishing vessels in a concentration. Visual acuity required.

PATROL (PAT) - General surveillance of a region.

SEARCH FOR FISHING FLEET (SFL) - Radar search of a large number of large craft in a known region.

SEARCH FOR SHIP (SSH) - The searching for a target ship based entirely on sensor (e.g., radar) detection.

TRANSPORT EQUIPMENT (TEQ) - The carrying of specified CG equipment from one point to another, e.g., helo, oil booms, oceano or weather equipment.

TRANSPORT PEOPLE (TPE) - The carrying of people or survivors from point to point.

TRANSIT (TRA) - The travel from one location to another at the economical cruise speed.

2.3.4 Flank Speed Task Definitions

DASH (DSH) - The travel at high speed from one location to the expected location of a distressed unit or people. Emphasis of this task is upon high sustained speed (minimum time).

INTERDICT (INT) - The travel at high speed from one location to the expected location of a target vessel. Emphasis of this task is upon high sustained speed.

3.0 SYNTHESIS TO CREATE SCENARIOS

3.1 General Approach

The purpose of analyzing the various Coast Guard missions was to identify the constituent elements of these missions so that a model, or paper Coast Guard, could be constructed and used for the evaluation of HPWC and conventional craft. The result of this synthesis, or modeling, is the scenario.

Scenarios are created by sequencing tasks in a flow chart format as seen in Figures 3-1 and 3-2. The particular order of sequencing the tasks is important in that the resulting scenario should represent, as closely as possible, the realistic situation that occurs in the field, or a particular situation that the user of the model desires to investigate. The flow chart format is necessary because, in trying to model any activity, decision points arise regarding the exact nature and frequency of subsequent events. Use of a flow chart enables a variety of subsequent events to be considered since any decision points can be identified and different paths or branches of the flow chart can represent the choices and the probability of occurrence of the follow-on activity.

To provide a less tedious method of constructing scenarios in the CREE Model, the tasks are pre-arranged in Functional Task Groups (modules) so that only a few "basic building blocks" need be sequenced. Any Program or mix of Programs can be modeled by arranging several Functional Task Groups in the flow chart format.

To utilize these flow charts to evaluate craft effectiveness, more information than just the task being performed needs to appear in the scenario flow chart. "How often" the task is performed must be considered, and therefore each path of the flow chart must be assigned a frequency or probability of occurrence. To relate the flow chart to reality, times, distances, and other task variables, must be entered for the tasks. Finally, with a number representing "how successfully" a craft performs an individual task (the subject of Volume II - "The Evaluation of Craft Performance in CG Programs"), sufficient information is available to evaluate craft performance in the scenario.

To summarize, a scenario is a model of single or multi-Program activity, organized in a flow chart format using defined Tasks or Functional Task Groups with assigned probabilities of occurrence, for the purpose of quantifying the effectiveness of resource performance in the particular Program or mix of Programs.

3.2 Functional Task Groups

During the examination of Coast Guard Programs, the one continual thought influencing the direction of the analysis was that eventually some methodology would have to be developed whereby useful scenarios could be conveniently constructed. "Useful" implies that the scenarios would have to accurately model the missions or programs sufficiently well so that craft would be realistically evaluated; and "convenient" implies simplicity in construction so that any user would not be overwhelmed by unnecessary complexity.

The idea that tasks could be used as the foundation of scenarios, and the usefulness of such scenarios was realized and validated early in this study. Several test case scenarios were constructed for two specific Programs - Search and Rescue (SAR) and Enforcement of Laws and Treaties (ELT). The preliminary evaluation techniques indicated that using these flow chart scenarios could provide realistic assessment of craft performance.

The detailed examination of the various Programs enabled identification of major areas of Operational Activity conducted by Coast Guard forces in support of the individual Program Objectives and Sub-Objectives. These major areas of operational activity, previously listed and described in Section 2.2, Operational Activities, provided the outline for prefabrication of basic building blocks to simplify the scenario construction process.

Specifically, several tasks were prearranged in a mini-flow chart format to represent an area of operational activity, e.g., Identification (of foreign fishing vessels), thus forming a Function Task Group. A Functional Task Group is a group of tasks that models an operational activity or function, and can be considered a module or building block for constructing a single or multi-Program scenario. It should be noted that although the Functional Task Groups cover all the previously listed Operational Activities, there is not necessarily a one-to-one correspondence between them. The creation of the Functional Task Groups simplified the scenario construction, yet maintained the capability of evaluating craft performance at the lowest level of activity - the task. Tasks are not eliminated, but rather prepackaged into groups for more manageable scenario construction.

Table 3-1 lists the Functional Task Groups and their most applicable Programs. Figure A-1 through A-18 in Appendix A illustrate these Groups in their flow chart format.

3.3 The Flow Chart Scenario

In the CREE Model, a scenario is a flow chart made up of the various tasks performed by a craft completing a series of operational activities. These tasks are selected by the user considering his concept of operations, and sequenced in a realistic manner. To describe task frequency, each path of the flow chart is assigned a probability of occurrence by the user.

The procedure of scenario construction and utilization has been simplified for the user. Basic scenarios have been constructed for use in the CREE Model and can be used as presented, or the user can construct his own by using the Functional Task Groups discussed in the previous section. If the user desires still more flexibility, he may develop his own Functional Task Groups from the supplied list of tasks, or he may even create new tasks. It is expected, however, that in the majority of cases, the user will develop his own scenarios by arranging and sequencing the existing Functional Task Groups. Scenarios constructed by this method are easily assembled, quickly modified and reasonably realistic.

TABLE 3-1

LIST OF FUNCTIONAL TASK GROUPS

FUNCTIONAL TASK GROUP	APPLICABLE PROGRAMS
1. Assist Group	SAR
2. Escort Group	SAR, ELT, PSS
3. Fight Fire Group	PSS
4. Identify Group	ELT
5. Inspect Group	ELT, MEP, PSS
6. Monitor Group	SAR, ELT, MEP, PSS
7. Patrol Group	SAR, ELT, MEP, PSS
8. Rescue Group	SAR
9. Rescue Return Group	SAR
10. SAR Search Group	SAR
11. Search Fleet Group	ELT
12. Seize Group	ELT, PSS
13. Sensor Search Group	ELT
14. Standby Group	SAR, ELT, MEP, PSS
15. Steam Group	SAR, ELT, MEP, PSS
16. Transfer Equipment Group	MEP, PSS, MSA
17. Transport Equipment Group	MEP, PSS, MSA
18. Work Equipment Group	MEP, PSS, MSA

Figure 3-1 illustrates a typical Fisheries Patrol scenario, highlighting two possible paths or sorties. This scenario was constructed using some of the Functional Task Groups in Table 3-1. Figure 3-2 shows the same scenario with the Inspect Group expanded illustrating the tasks of this group.

The scenario of Figure 3-1 envisions a "daily" operation of some high speed craft. The duties assigned to this vessel include scheduled daily operations to the active fishing areas to gather data on the foreign and domestic fishing activity plus some unscheduled high speed responses to reported violations.

The first decision to be made is whether the "case" is scheduled or unscheduled, i.e., routine patrol or response call. In reality, this asks if the vessel would steam at Full or Flank (modeled as Transit and Interdict Tasks within the Steam Group). This decision is represented by a "decision diamond" in Figure 3-1. Since two choices of action are possible, the user must assign a probability of occurrence to each path from the decision diamond. In this example, the authors chose 0.8 for the routine patrol and 0.2 for the response call.

The total of the probabilities assigned at any one decision diamond must equal 1.0 since everything coming into the diamond (1.0) goes out in two or more branches. The rationale for assigning the probabilities depends upon how the user wishes to use the CREE Model. If the user is trying to represent operational activities as they exist in the fleet, the user must be familiar with those operations and assign probabilities accordingly, using both the data from his Program's reports as is available as well as his own experienced estimates. If the user is attempting to answer a "what if" or other hypothetical problem, then assignment of the probabilities is based upon the problem at hand, coupled with logical and good judgment. The following discussion on the rest of the scenario shown in Figure 3-1 will shed some more light on the rationale of assigning probabilities.

Considering the routine patrol side of the scenario, the first Group in the sequence is the Steam Group, which allows the user to choose the vessel speed from homeport to the operating area (refer to Figure A15, Steam Group). Since this side of the scenario has already been determined to be a routine patrol, the task has thus been established as Transit.

Following the Steam Group, the Identify, Inspect and Seize Groups follow in order, with two decision diamonds between them. The "Re-Do" decision is to choose between proceeding with an inspection having just satisfactorily identified some fishing vessels, or to continue with identification of some more vessels. The probability of either of these paths is equal (0.5) in this example. The "seize" decision allows the user to establish the frequency of seizure, in this example 10 percent of the inspections result in seizure. If no seizure occurs, the vessel can return to homeport via the "next?" decision diamond and the lower Steam Group (P = 0.7), or proceed on a response call via the upper Steam Group (P = 0.3).

TYPICAL ELT SCENARIO
ILLUSTRATING TWO POSSIBLE SORTIES

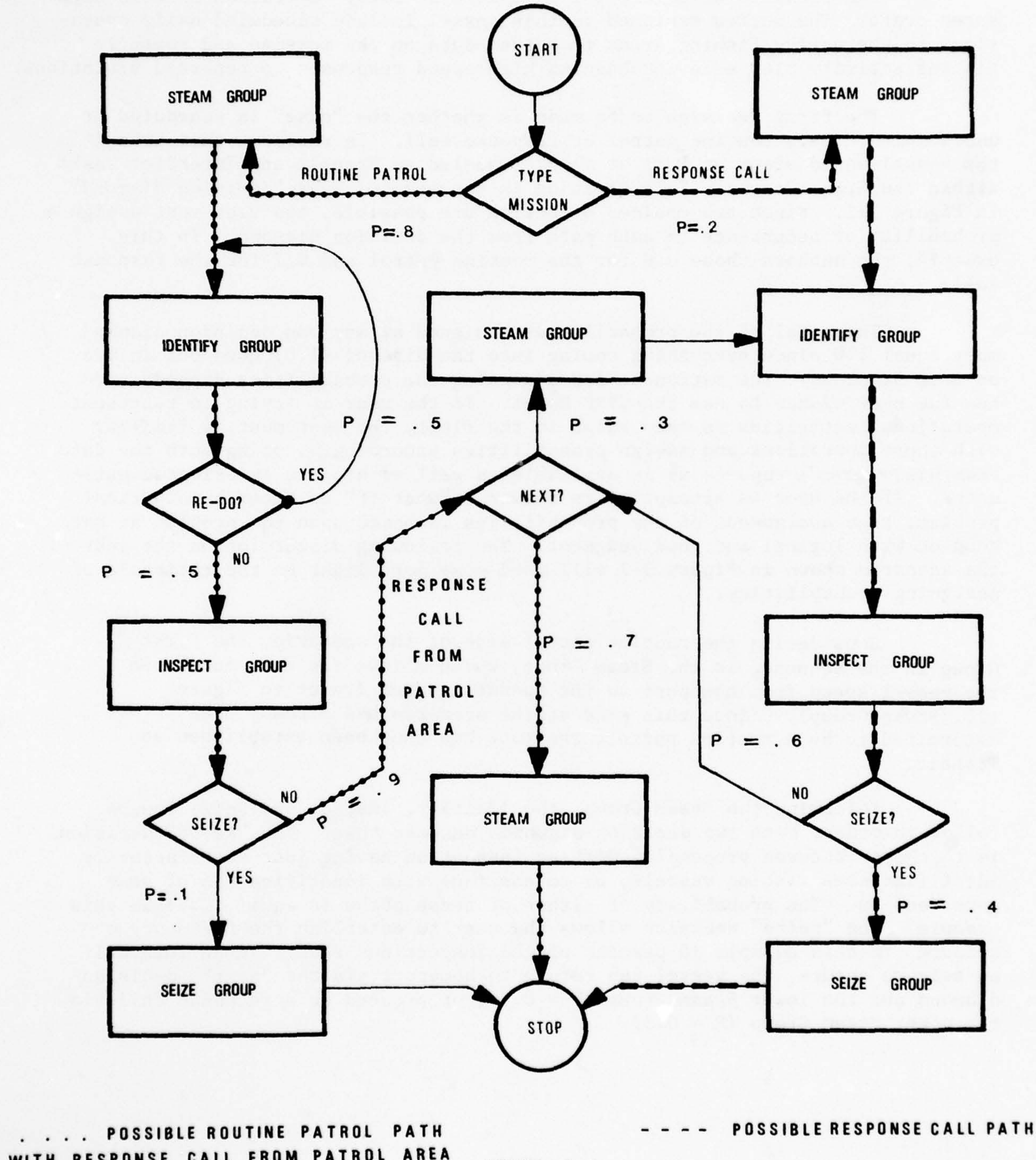


FIGURE 3-1

TYPICAL ELT SCENARIO WITH INSPECT FUNCTIONAL TASK GROUP EXPANDED

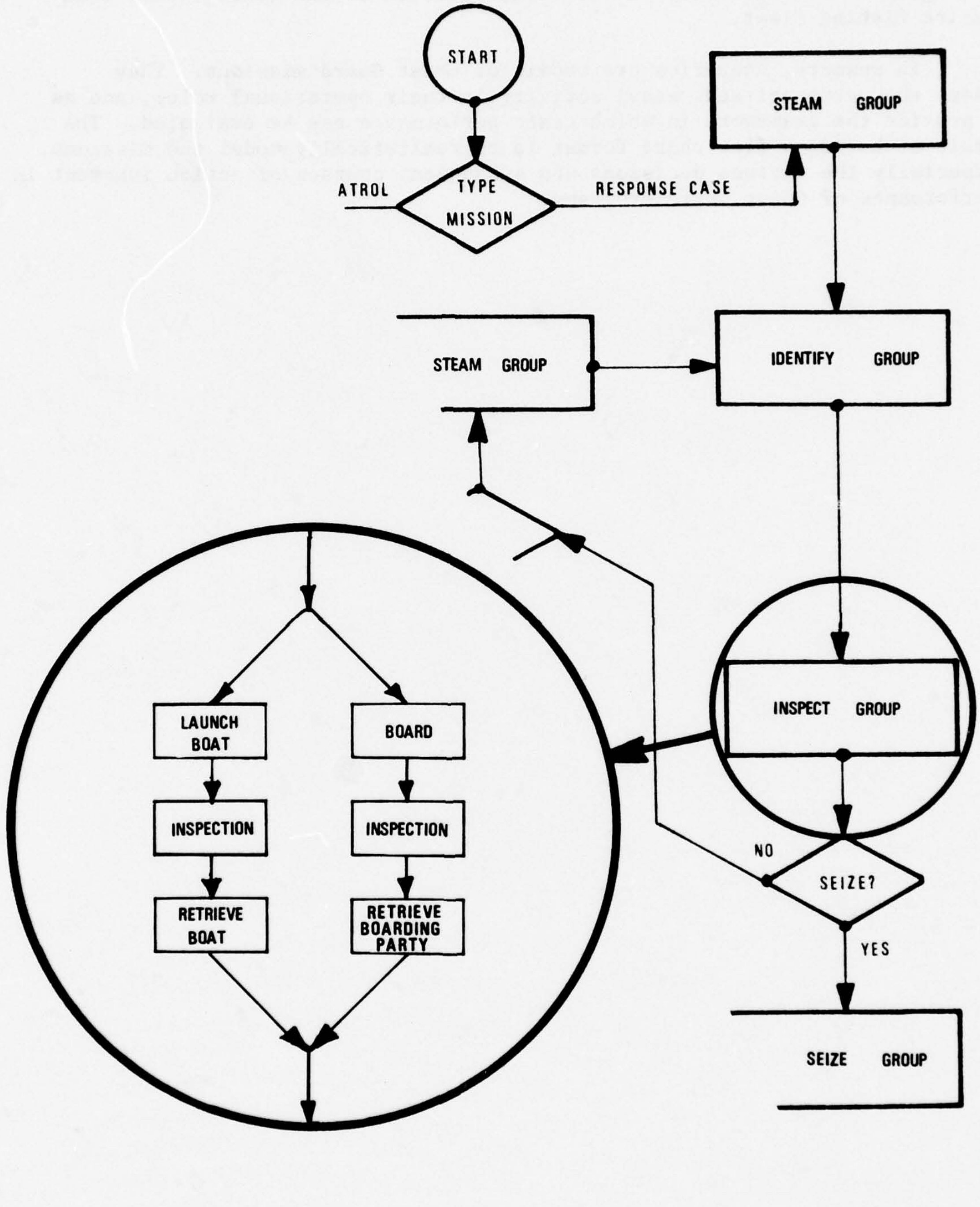


FIGURE 3-2

The response call side of the scenario is similar to the routine patrol side, except that the probabilities are different to reflect the different intent of the unscheduled case. For example, assuming that any responses would be to reported violations, the probability of seizure is higher after the inspection. In addition, although not detailed in Figure 3-1, the Identify Group (Figure A-4) would focus on the identification of one craft rather than the entire fishing fleet.

In summary, scenarios are models of Coast Guard missions. They represent the personnel and vessel activity in their operational roles, and as such, provide the framework in which craft performance can be evaluated. The rationale of having a flow chart format is to realistically model the missions, and especially the various decisions and subsequent courses of action inherent in the performance of Coast Guard Programs.

4.0 CONCEPTS OF OPERATIONS

The basic question addressed by this study focuses on the potential for utilization of HPWC and conventional craft in Coast Guard missions. At first glance it may appear that the best way to reach conclusions would be to take candidate craft, find a suitable scenario and evaluate all craft against one another in that scenario.

The problem is somewhat more complex than appears at first glance, however. Each type of craft, depending upon its own individual capabilities, has specific advantages and disadvantages. Some craft achieve high speed in heavy seas while others achieve high speed in only calm water. One type of HPWC is amphibious, and another has an extremely deep draft. Some craft have excellent maneuverability, others only marginal maneuverability. In short, the different types of craft demand to be utilized to maximize their advantages and minimize their disadvantages.

The various types of craft must be evaluated on their merits and in their ability to perform selected missions rather than simply against some other vessel or group of vessels in a "standard" scenario. To say that an Air Cushion Vehicle (ACV) has no potential for utilization in Coast Guard missions based upon its inability to effectively perform a standard high seas Enforcement of Laws and Treaties (ELT) mission is unfair. In this example the primary advantage of an ACV, its amphibious capability is not required, yet the major disadvantage of the ACV, its limited capability in high sea states, is demanded.

The point is, given the complex distribution of missions within the Coast Guard, a single point evaluation of the various craft is not only a small part of the picture, it could also very well lead to grossly incorrect conclusions.

In order to accurately assess the potential for utilization of any craft, a high degree of flexibility is needed in the evaluation process. There are simply too many possible combinations of missions, types of craft, methods of deployment, geographical and environmental factors to be addressed to let one arbitrary set of Operational Requirements be assembled into a standard scenario to be used as the basis for evaluation. Furthermore, since any evaluation process is inherently subjective, it is important that any evaluation procedure provide a high degree of user flexibility in defining Operational Requirements.

The purpose of Concepts of Operations is to provide the user of the CREE Model with freedom of choice, within an organized procedure, to (1) establish his own operational requirements, (2) construct his own scenarios, and (3) select his own craft together with suitable methods of deployment for evaluation. This section addresses these three items.

4.1 Craft Selection and Deployment

One of the major segments of Concepts of Operations (see Figures 1-1 and 1-2) is the selection of the specific craft to evaluate plus their method of deployment. As stated previously, this is often the initial step in the use of the CREE Model. Whether it is or not depends upon how the user chooses to employ the model.

In any case, the process of Craft Selection and Deployment is not totally independent of the specification of the Operational Requirements nor the Scenario Construction. The three major segments of Concepts of Operations are interrelated and interdependent.

For example, once the user has chosen which Operational Activities he desires to model, the scenario is, content-wise, well determined. At this stage, the choice of craft must be made in a judicious fashion, keeping in mind craft deployment schemes. Furthermore, the user must keep in mind the sea state distribution and other requirements that have been chosen, as these also have an influence on the craft chosen for evaluation.

Although the CREE Model will evaluate almost any combination of scenario, requirement and craft, it helps to start the process in a realistic and logical fashion and not waste time and effort demanding that certain craft be operated in obviously unsuitable situations.

Users must have a working familiarity with Coast Guard Operations in order to effectively use the CREE Model. Reference 1, "Technical and Operational Characteristics of HPWC," provides the characteristics of generic HPWC types with respect to conventional craft, and craft selection can be made from this report.

The following HPWC and conventional craft are available for selection in the CREE Model:

CRAFT

HYDROFOIL, Submerged Foil
HYDROFOIL, Surface Piercing Foil
ACV - Air Cushion Vehicle, low cushion pressure to length ratio
ACV - Air Cushion Vehicle, high cushion pressure to length ratio
SES - Surface Effect Ship
PLANING Craft
CATAMARAN
HYBRID Vessel
CONVENTIONAL Craft

Once the type of craft is decided upon, the size (length or displacement), the design speed and the fuel fraction (fraction of useful payload carried as fuel) must be specified. These concept-level characteristics are all that need be specified by the user regarding HPWC and conventional craft in order to enter the Craft Characteristics Computer Program (CHAR) and start the CRAFT/TASK EVALUATIONS. (Refer to Figure 1-1 for the block diagram of the overall CREE Model.)

The following Coast Guard craft are also available for selection in the CREE Model:

CRAFT

MRB 26'
PWB 32'
UTB 41'
MLB 44'
MLB 52'
ANB 55'
ANB 63'
WPB 82'
WPB 95'
WMEC 210'
WMEC 270'
WHEC 378'

Since these craft actually exist, only the type need be specified by the user. The size, speed and fuel fraction of these units are fixed.

The method of craft deployment chosen has a large impact on the scenario. For example, having a three-day endurance limited craft in a twenty-one day continuous operations scenario is inappropriate. Once the user has decided how he would like to operate a craft, the scenario must be pieced together in accordance with the desired method of deployment. Conversely, given a scenario, the method of deployment has been fairly well predetermined.

Broadly speaking, two categories of deployment methods can be considered, a "daily" operation and an "extended" operation. Since the CREE Model is presently limited to considering a single craft for a single job, more exotic methods of deployment like "mother-ship" or "dual-unit responses" must be handled on a special case basis.

Likewise, since the CREE Model does not addressed alternative levels of personnel manning and support requirements, to consider non-standard approaches, e.g., three crews for two craft or pooled manning/maintenance personnel, requires the user to exercise imagination in scenario construction and structure his needs to the limits of the model.

Nevertheless, there is still some flexibility regarding the choice of deployment of the selected craft in this model. From the two broad categories mentioned above, several sub-groupings are possible. For example, given either broad category of deployment there are three conceivable methods of deployment for most craft. They are as follows:

a. Unscheduled cases, as in response to a reported ELT, PSS or MEP violation.

b. Infrequent but scheduled cases, such as escorting an LNG tanker arriving to discharge cargo.

c. Routine scheduled patrols such as morning and evening harbor patrols in PSS or MEP, or weekend SAR patrols in areas of high recreational boating.

The primary difference between the "daily" operation and the "extended" operation is that in the former, all periods of time can be assumed to be directly contributory to the accomplishment of the job, whereas in the latter there will necessarily be periods of non-productive waiting, for example, waiting for daylight to continue the boarding and inspection of fishing vessels while on fisheries patrol. For the "extended" patrols, these factors must be recognized and considered at this point with craft selection and later in scenario construction.

In summary, this is the point in the development of Concepts of Operations where the user must stop and realistically think about tying everything together regarding his operations. It is where the user sets the stage for using his choice of craft in his scenarios.

4.2 Operational Requirements

"Operational Requirements" in the context of the CREE Model, are the details that describe the jobs that need to be performed. Although there are numerous particulars that could enter into descriptions of Coast Guard activities, only a few are significant in craft evaluation and consequently significant enough to be included in this model.

To have complete scenarios, certain information describing the tasks must be specified to flesh-out the skeleton flow chart. Since the basic format of the scenario has been rigidly defined, the detailed information to be specified must be in a compatible format. This structured organization applies to format only. The user is free to specify any value for the task variables.

4.2.1 Geographical Considerations

One of the first considerations that must be addressed by the user is the distance factors involved in the scenario. Although the specific geographical area will undoubtedly be clearly in mind at the outset, sketching the scenario's trackline and op area on a chartlet may be of benefit. Blank work sheet chartlets have been furnished and appear in Figure B-1 through B-9, with four chartlets depicting the Ocean Regions, three depicting the Coastal Regions and two depicting typical Port Regions.

To use these work sheets, sketch in the op area boundaries and tracklines, and estimate the transit distance from homeport (and return if different). Within the general op area, several other distances may be required depending upon the actual scenario constructed and the specific Operational Activities (Functional Task Groups) conducted. For example, the SAR Search Group (Figure A-10) requires a user input of initial search area and a radar or visual sweep width. Estimation of these distances may be easier if the scenario geographical details are sketched on the work sheet chartlet.

4.2.2 Time

All tasks take a finite amount of time to complete. This time is either dependent upon the distances and craft speeds-of-advance or

strictly dependent upon the type of task. If the task is distance and speed related, the model "timekeeper" calculates the time to complete the task, but it the task is independent of distance and speed, the user must specify the length of time required for each task.

This process is not as difficult as it may first appear, and by using the Functional Task Group work sheets, the process is routine. Reviewing Figures A-1 through A-18, it will be noted that every task requiring a time input is labeled accordingly with a blank space for the entry. When the scenario is constructed, estimate the time required for each task, for example, the lowering or raising of a small boat to transport the inspection party to a fishing vessel would take approximately 0.25 hours. This 0.25 hours is then entered in the "T=___HRS" under the appropriate task on the work sheet. As with creating the entire scenario, estimation of times requires experience in the particular mission area and logical judgment.

4.2.3 Sea State Distribution

The expected sea state distribution in the area of operations is one of the more important Operational Requirements specified in this model. All speed and craft motion-related tasks are evaluated with considerations of this inputted sea state distribution.

As with the other Operational Requirements, the selection and entry of this sea state distribution has been organized for the user. Ten typical distributions from average SS=0.5 to average SS=5.0, have been catalogued and each appears in graphical form in Figures C-1 through C-10. The entire selection of sea state distributions is summarized in Table C-1.

4.2.4 Visibility Distributions

The expected visibility distribution must also be specified by the user in defining his Operational Requirements. Three typical visibility distributions, Good, Fair and Poor, have been developed and appear in Appendix D, in Table D-1.

4.2.5 Towing Distribution

The expected distribution of vessels to be towed must be specified by the user. As with the other distributions, this process has been incorporated by providing the user with five typical towing distributions. These are presented in Appendix E, Figures E-1 through E-5, and summarized in Table E-1.

4.2.6 Cargo Carrying Requirements

Inasmuch as some of the Operational Activities involve the transportation, handling and working of equipment, it is necessary to specify the weight and deck area (footprint) requirements of the particular cargo. This is accomplished by the user on the Functional Task Group worksheet for "Transport Equipment" when that particular group is used. Appendix F is a table of these details for the more commonly carried items.

4.2.7 Search Details

To calculate the success or failure of a search in some Functional Task Groups, specific search related information must be supplied by the user. This information, like the proceeding cargo information, is entered on the specific Group Worksheet when required. (See Figures A-10 and A-13.) The information required further defines the intended search and includes items such as sweep width, initial search area, desired number of searches, estimated error in initial position, and target speed, and so forth.

4.3 Scenario Construction

There are four major steps involved in constructing and using a scenario:

a. Determine applicable Functional Task Groups
b. Develop flow chart and establish probabilities of occurrence
c. Fill in detailed information on Group Worksheets
d. Assemble computer input in coded format

The first step, having decided what should be modeled, is to select those specific Functional Task Groups that most accurately describe the Operational Activities under consideration. The rationale of this first step is discussed in the previous sections of this report, specifically Sections 2.0 and 3.0 which address the analysis and synthesis of Coast Guard Programs to create scenarios.

Secondly, with consideration of the craft being evaluated and the method of deployment, arrange the selected Functional Task Groups in a flow chart format such that the sequence of events depicts a realistic operational situation. This also includes the specification of the probabilities of occurrence of each path at each decision point. This procedure of arranging the Groups and the setting of the probabilities is discussed in Section 3.3, Flow Chart Scenario with an example ELT scenario, repeated for convenience here in Figure 4-1.

It can be seen that in this flow chart, the Functional Task Groups may be used more than once, and many are repeated several times. In the sequencing of the Functional Task Groups into a scenario, a four-digit identification code is assigned to each Group to distinguish between these Groups appearing more than once, and to identify each Group for subsequent programming in the CREE Model computer program. The first two digits of this identification code are the assigned Group Numbers that appear in the upper left hand corner of the Group worksheets (Figures A-1 through A-18). The second two digits represent the occurrence of the Group in the flow chart and can be entered by the user on the upper right hand corner of the same worksheets. For example, the Steam Group in the bottom center of the scenario in Figure 4-1 has the identification code of 1504. The assigned number for the Steam Group (Figure A-15) is 15, and in this scenario, this is the fourth occurrence of the Steam Group. In this scenario, there are also Steam Group numbers 1501, 1502 and 1503 which represent the first through the third occurrences of the Steam Group. It is important to note that

TYPICAL ELT SCENARIO WITH DECISION POINT PROBABLITIES AND GROUP IDENTIFICATION CODES

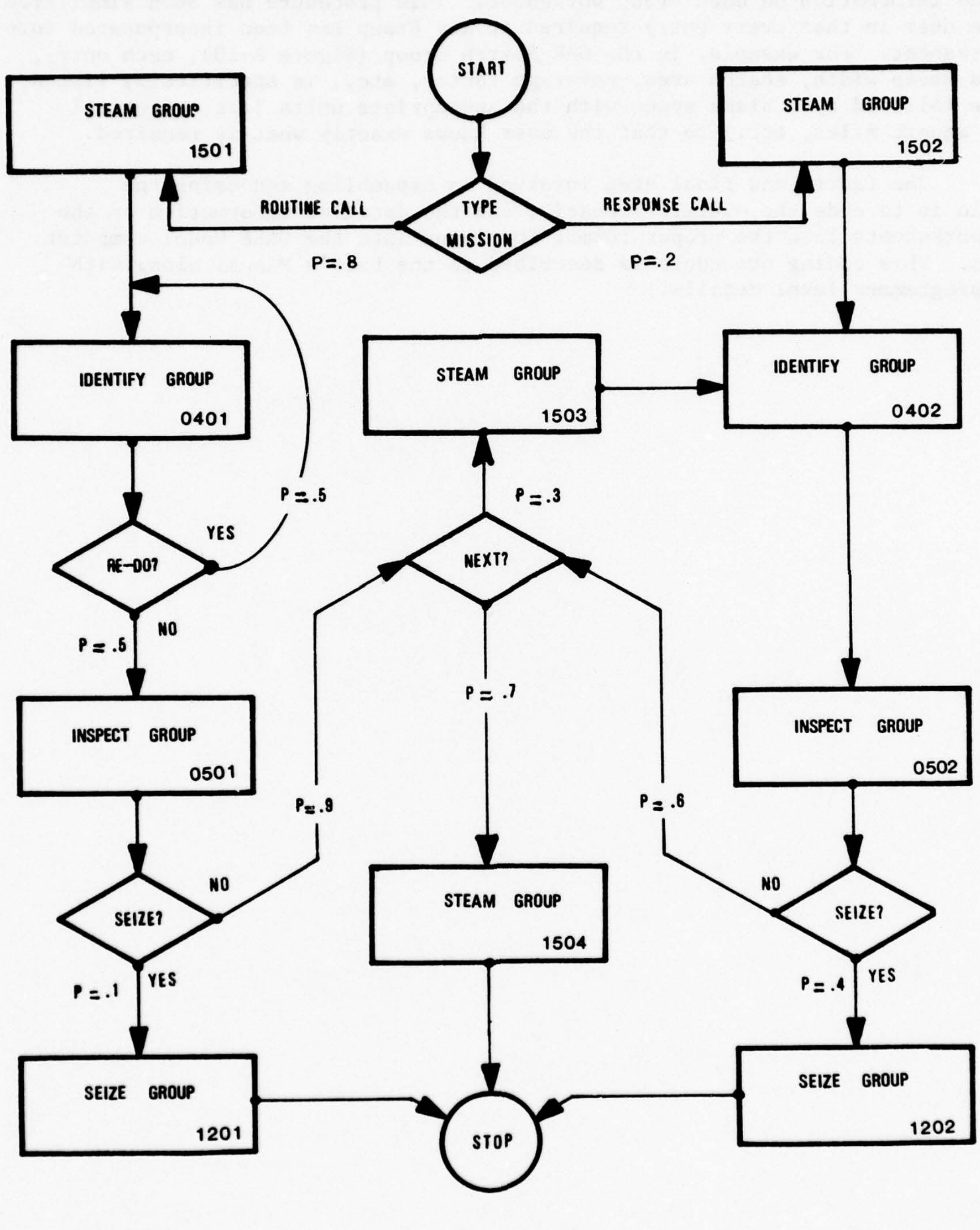


FIGURE 4-1

although the same Group may appear more than once, the internal distances, times and probabilities within these repeated Groups will more than likely be different, and hence the reasons for individual work sheets and identification codes for each Group occurrence.

The third step involved in constructing a scenario is to fill in this detailed information on each Group worksheet. This procedure has been simplified for the user in that every entry required in any Group has been incorporated into the worksheet. For example, in the SAR Search Group (Figure A-10), each entry, such as sweep width, search area, coverage factor, etc., is specifically listed by name followed by a blank space with the appropriate units (e.g., nautical miles, square miles, etc.) so that the user knows exactly what is required.

The fourth and final step involved in assembling and using the scenario is to code the overall scenario, and the detailed information on the Group worksheets into the proper format for input into the CREE Model computer program. This coding procedure is described in the User's Manual along with other programmer level details.

5.0 SUMMARY

This report documents the analysis of Coast Guard Programs and the logic of the structured synthesis necessary to obtain useable scenarios for the Cutter Resource Effectiveness Evaluation Model which evaluates craft performance of Coast Guard missions. This volume contains the necessary information for the users of the CREE Model to realistically model their particular operational area in a flow chart formatted scenario so that craft performance evaluation can be subsequently conducted. Detailed listing of a spectrum of operational requirements are presented as well as a typical sample scenario. Subsequent volumes of this series address the actual evaluation procedure and utilization of the CREE Model.

6.0 REFERENCES

1. Hamilton, Pritchett and Hudgins, "Technical and Operational Characteristics of High Performance Watercraft." DOT Report #CG-D-193-75, February 1975.

ASSIST GROUP

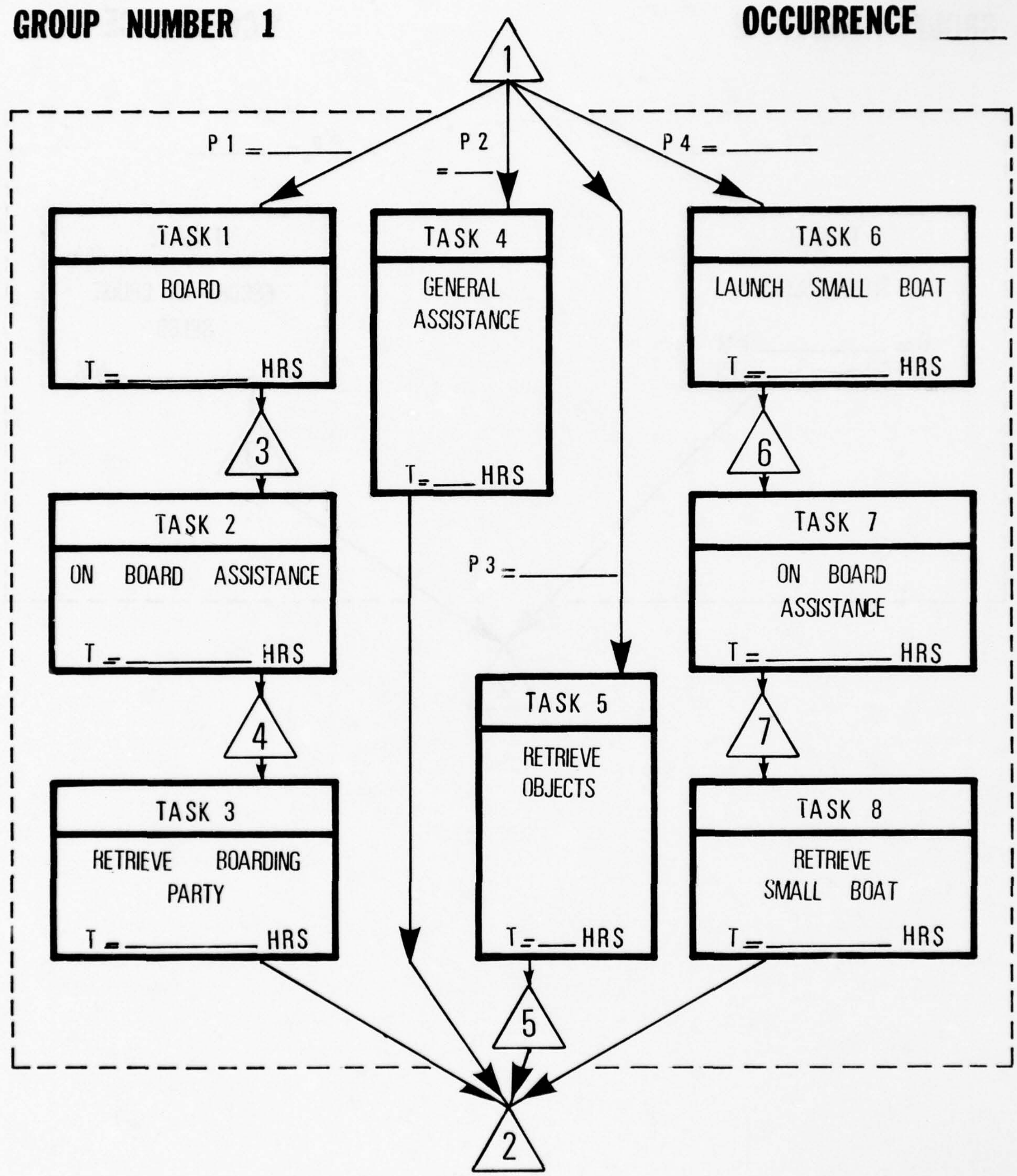


FIGURE A–1

ESCORT GROUP

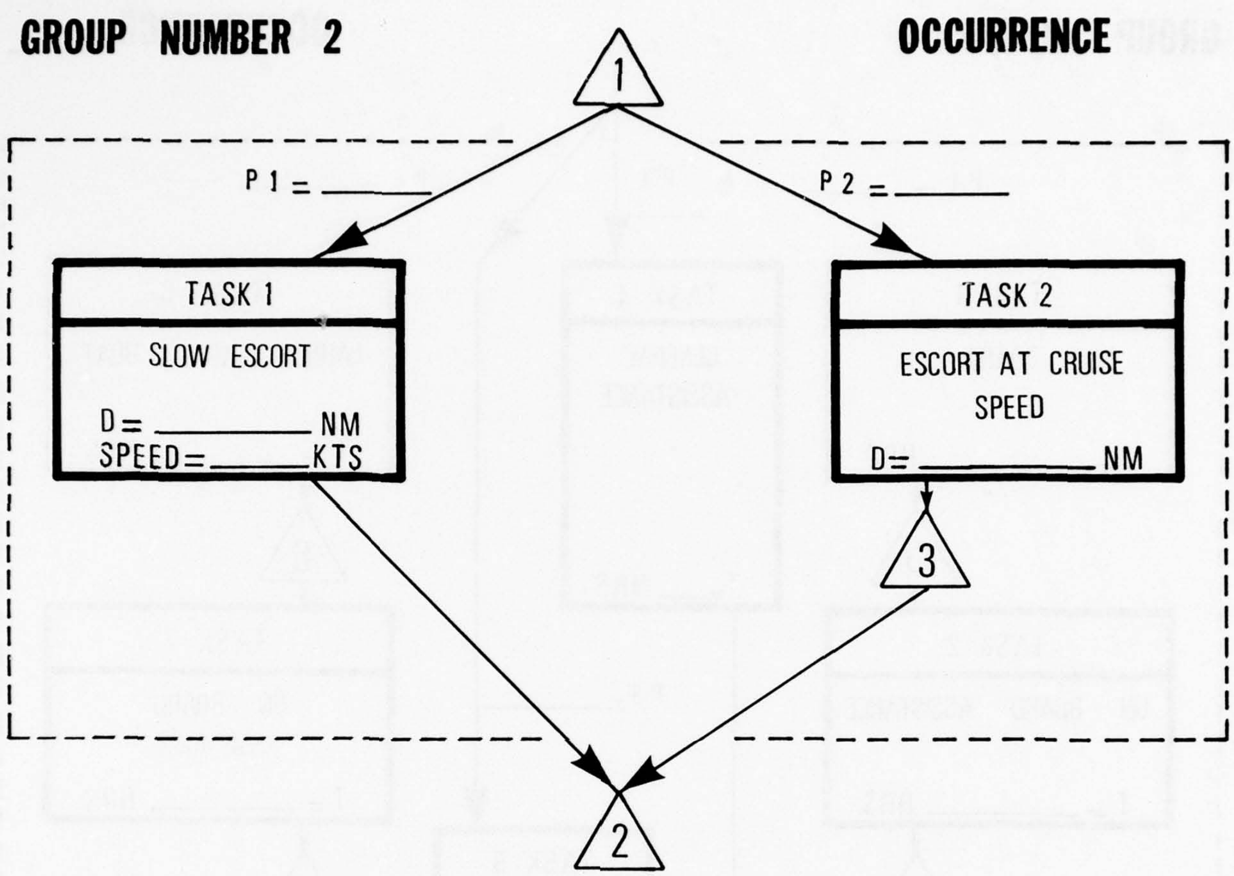


FIGURE A–2

FIGHT FIRE GROUP

GROUP NUMBER 3 **OCCURRENCE ____**

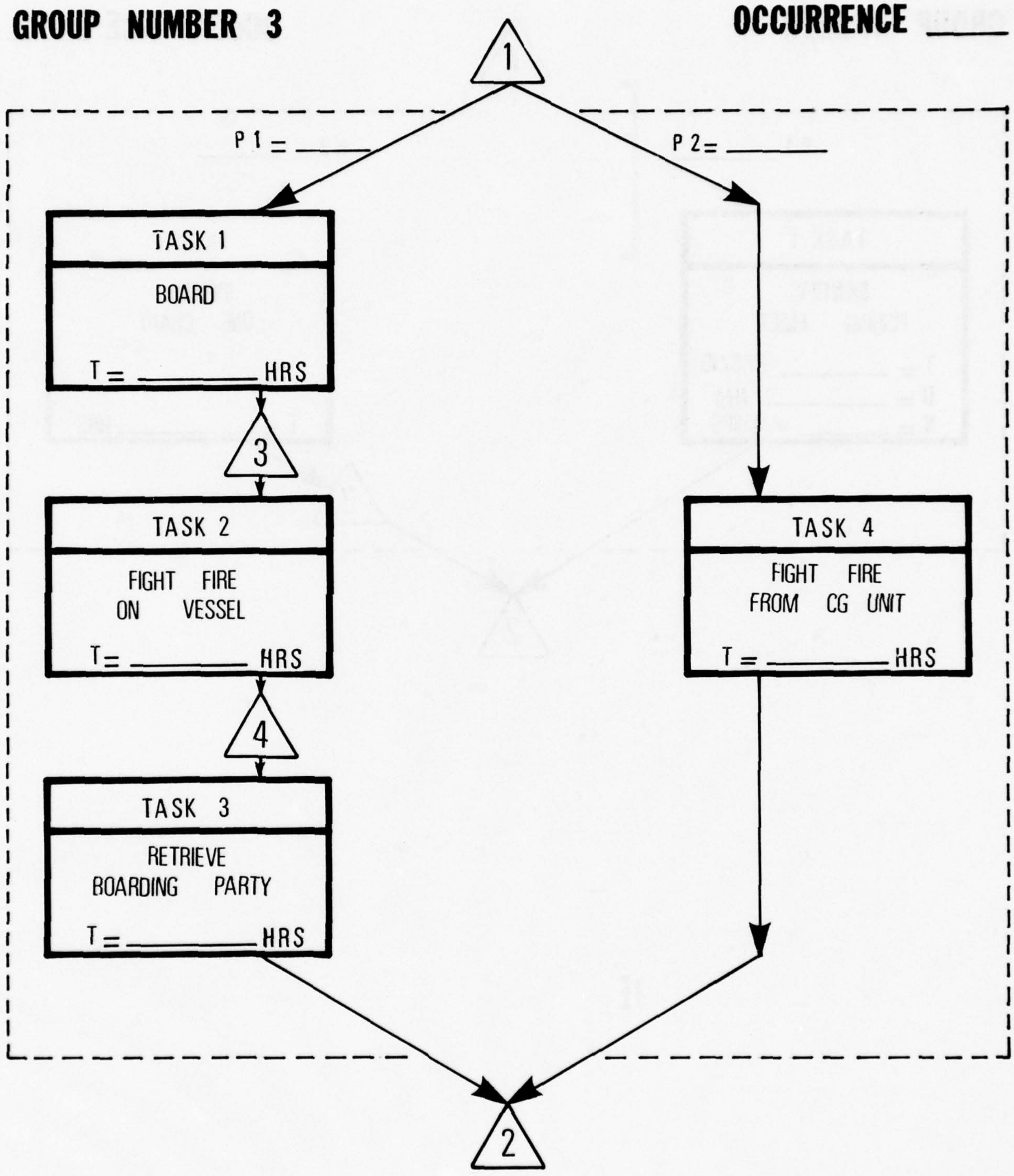


FIGURE A-3

IDENTIFY GROUP

GROUP NUMBER 4 **OCCURRENCE ____**

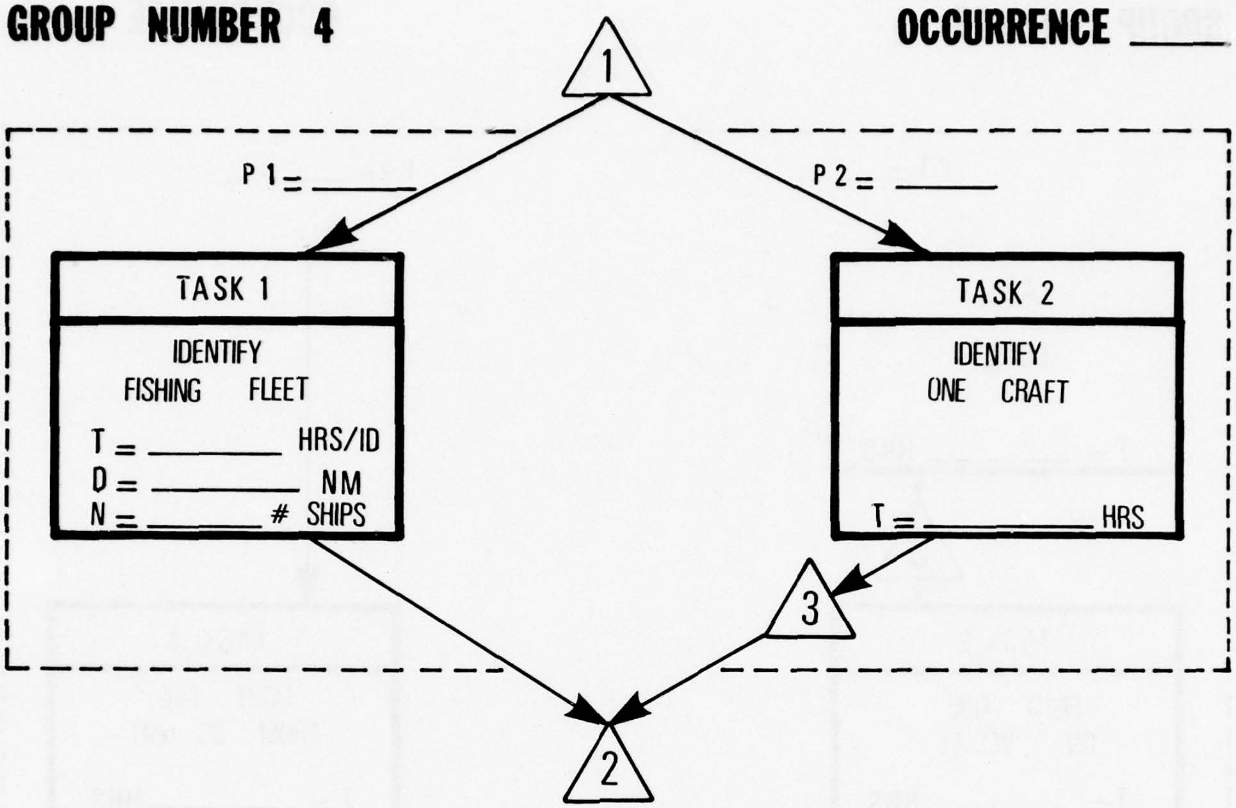


FIGURE A-4

INSPECT GROUP

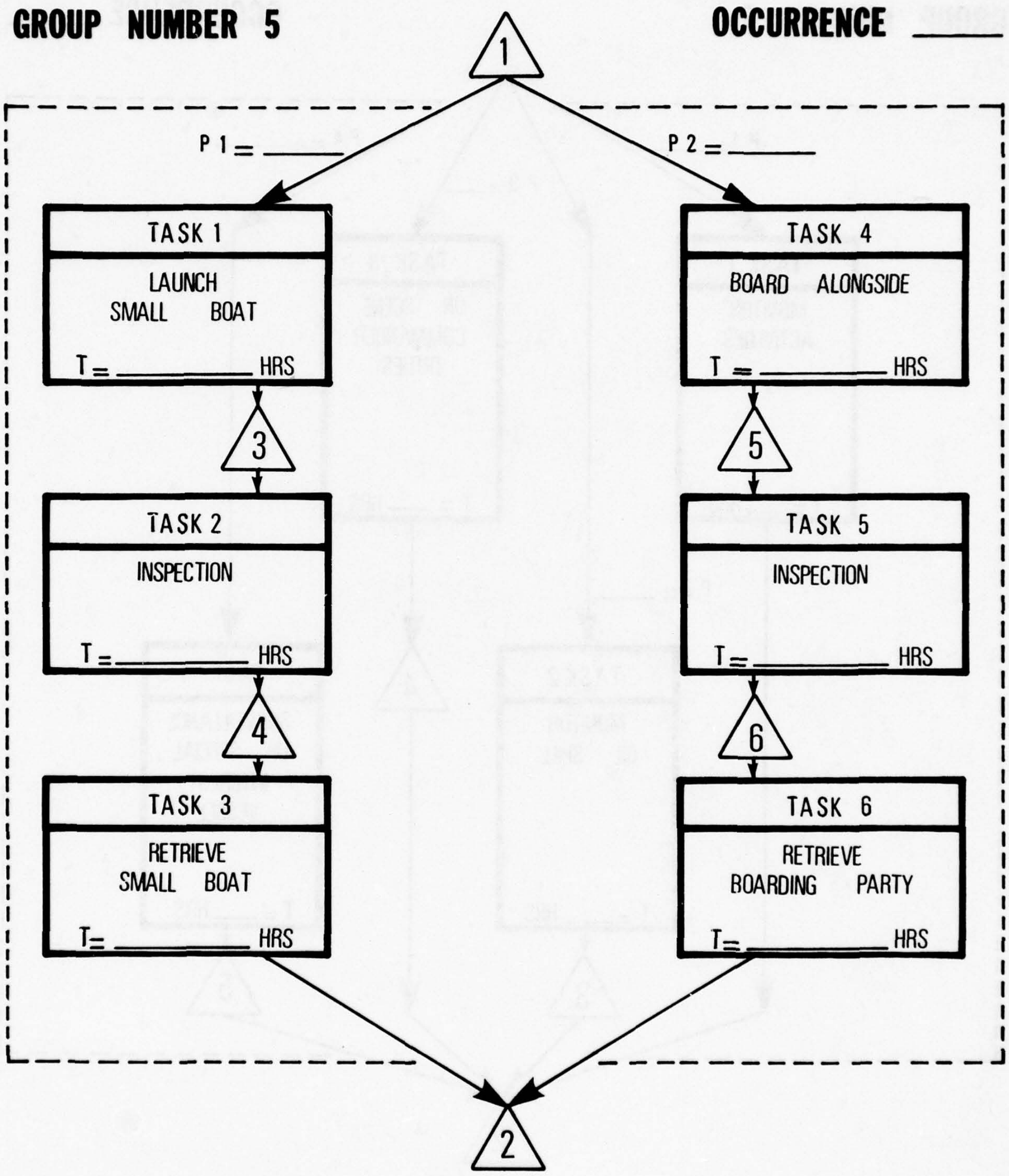


FIGURE A–5

MONITOR GROUP

GROUP NUMBER 6 **OCCURRENCE ____**

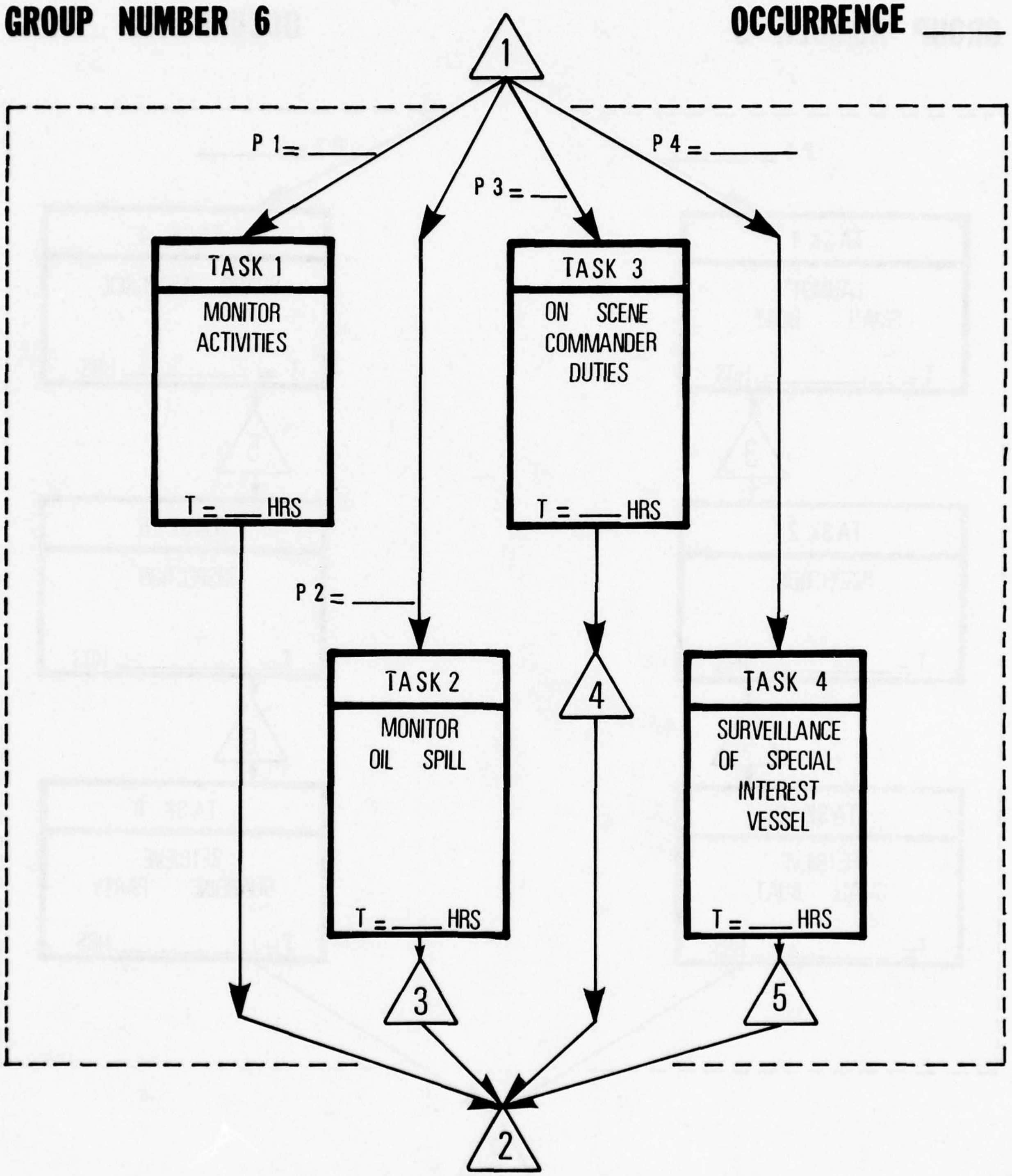


FIGURE A–6

PATROL GROUP

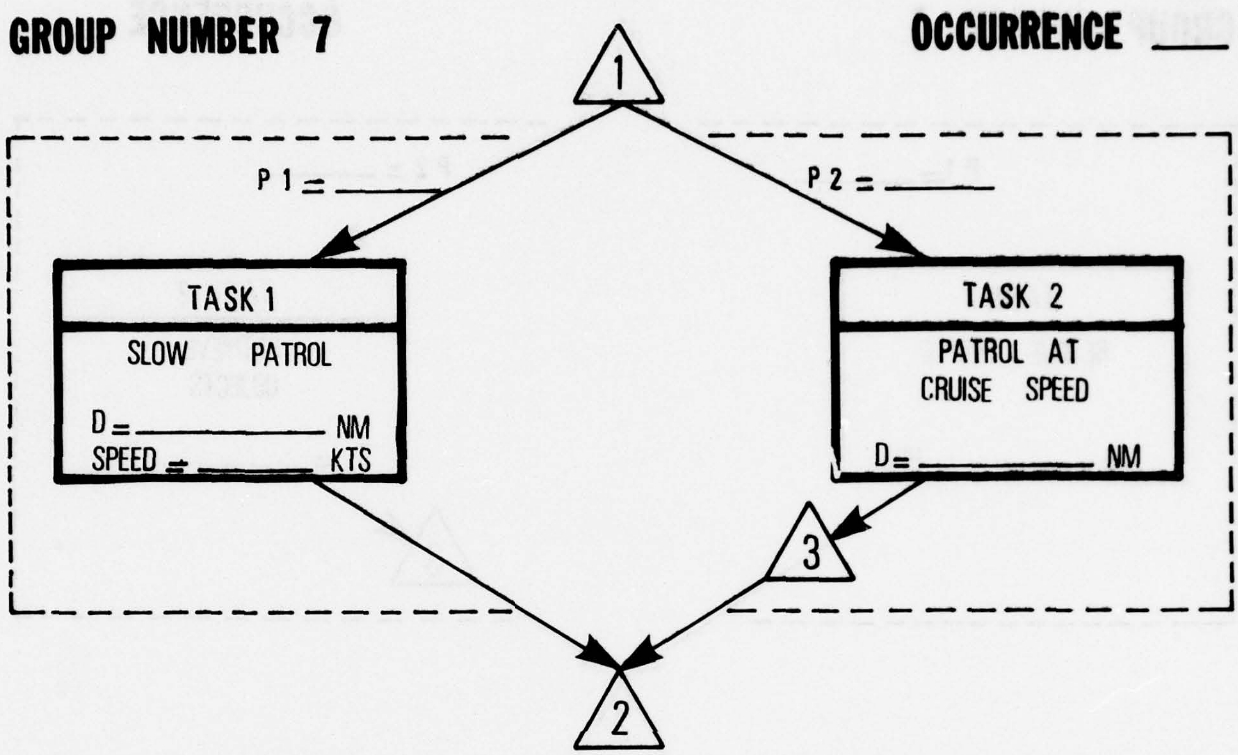


FIGURE A-7

RESCUE GROUP

GROUP NUMBER 8 **OCCURRENCE ____**

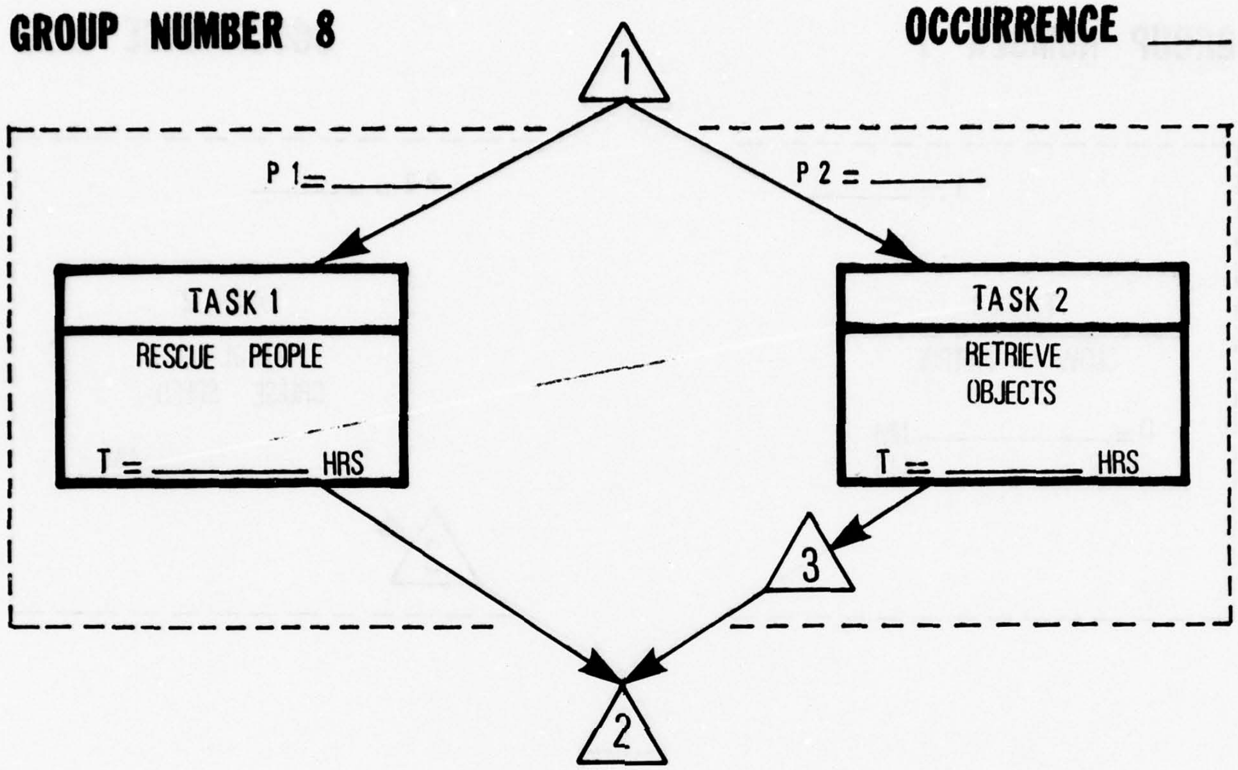


FIGURE A-8

RESCUE RETURN GROUP

GROUP NUMBER 9 **OCCURRENCE ___**

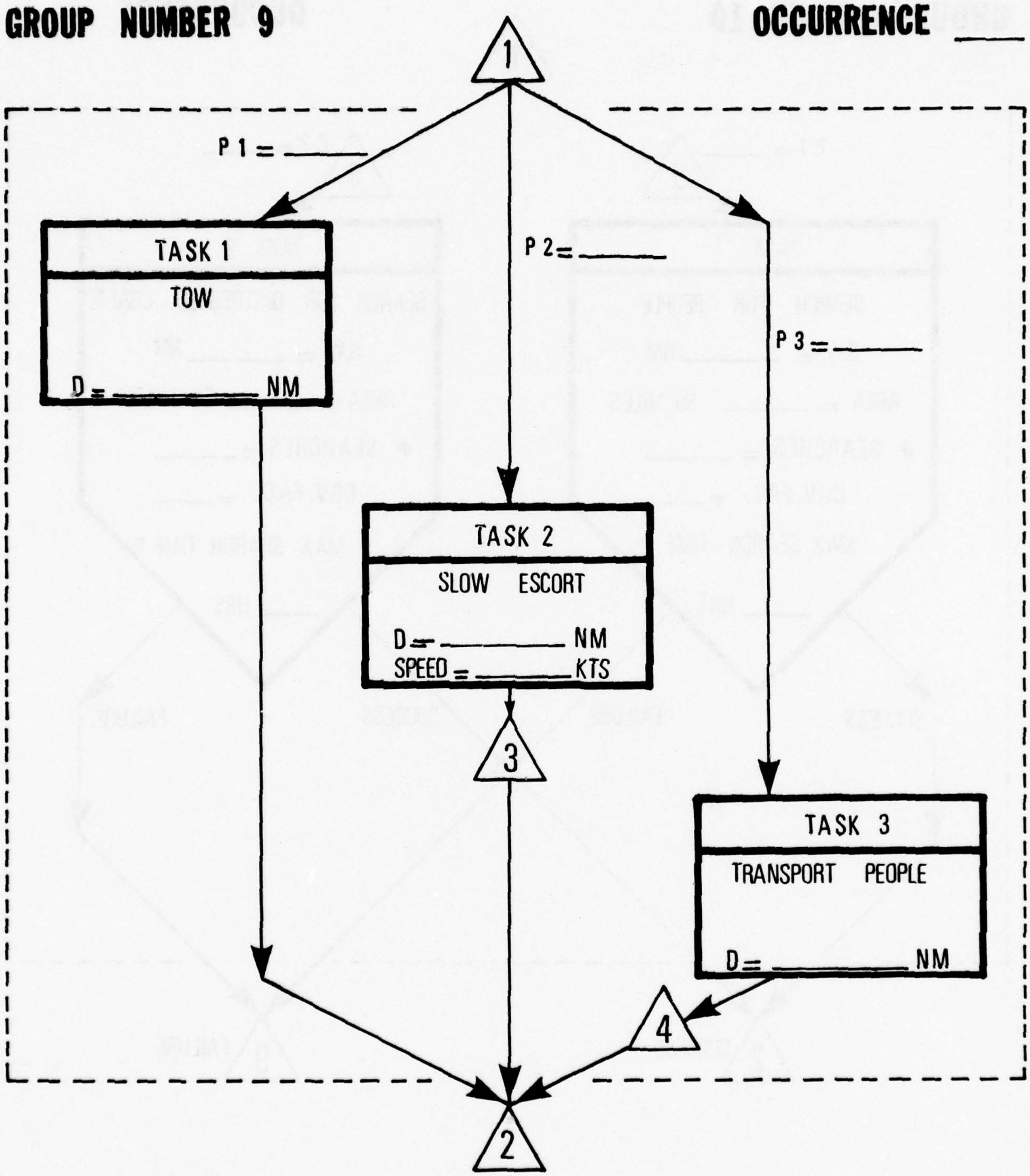


FIGURE A-9

SAR SEARCH GROUP

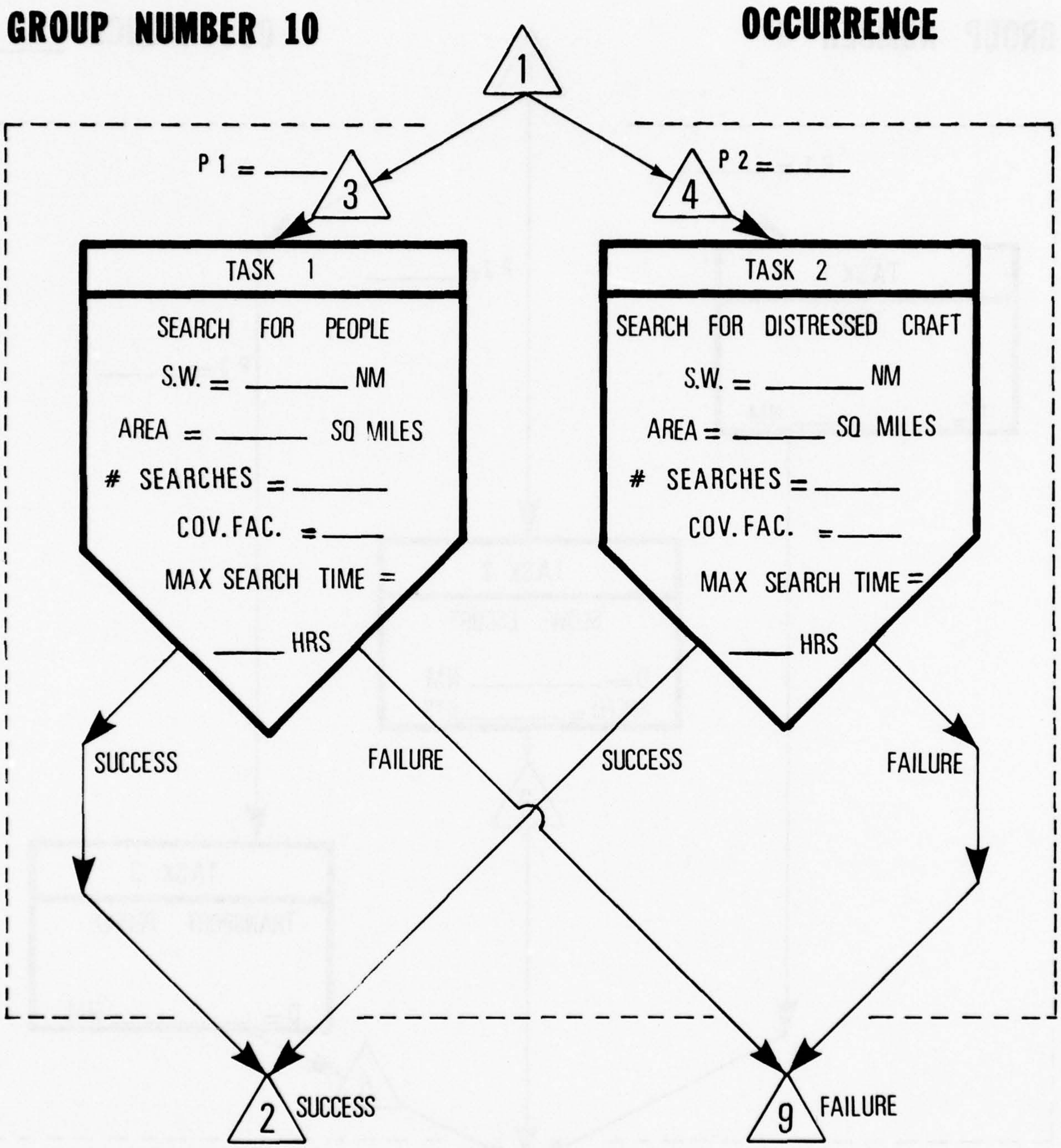


FIGURE A-10

SEARCH FLEET GROUP

GROUP NUMBER 11 **OCCURRENCE ____**

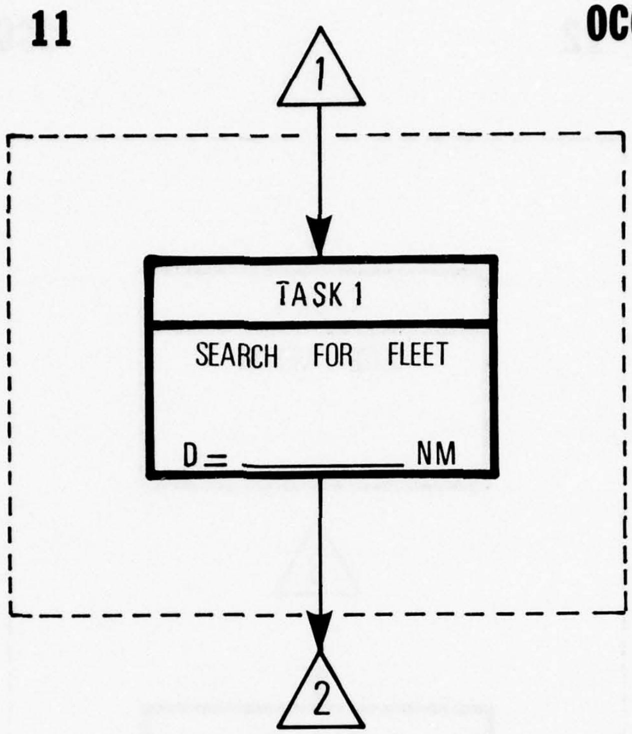


FIGURE A-11

SEIZE GROUP

GROUP NUMBER 12 **OCCURRENCE ____**

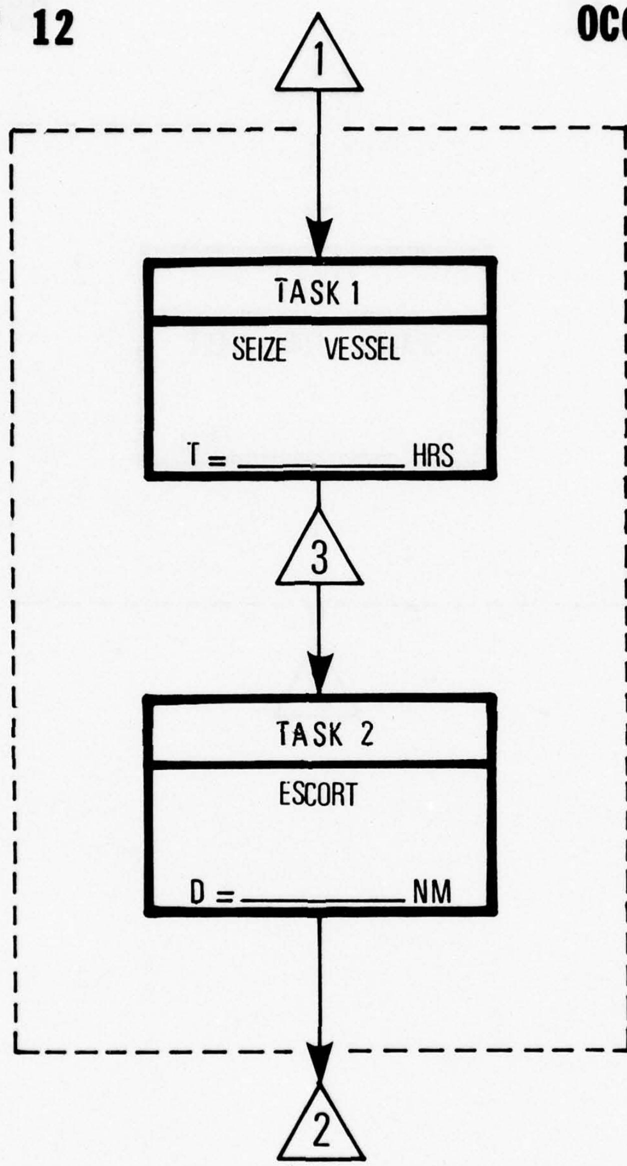


FIGURE A-12

SENSOR SEARCH GROUP

GROUP NUMBER 13 **OCCURRENCE ____**

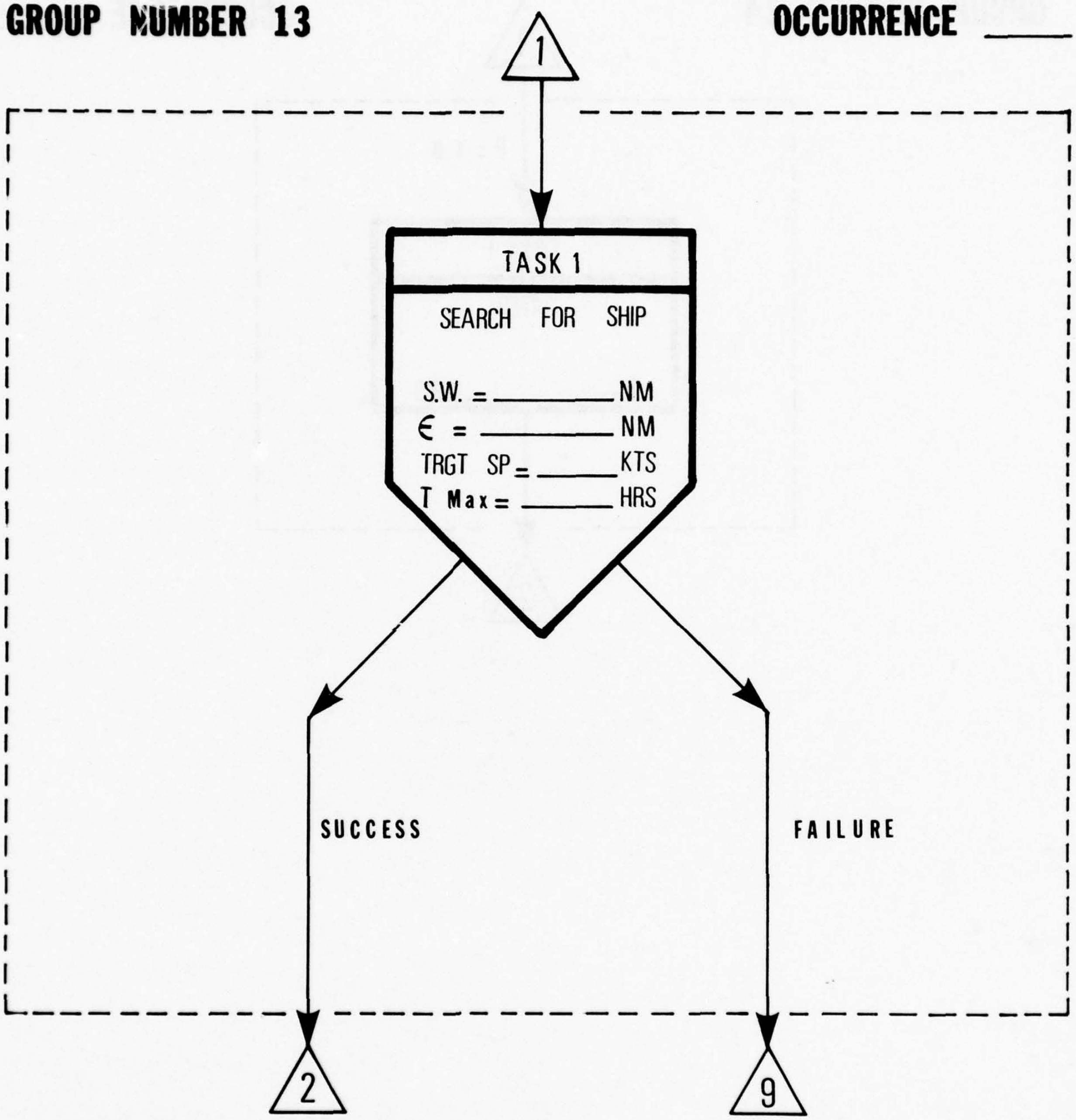


FIGURE A-13

STANDBY GROUP

GROUP NUMBER 14 **OCCURRENCE _____**

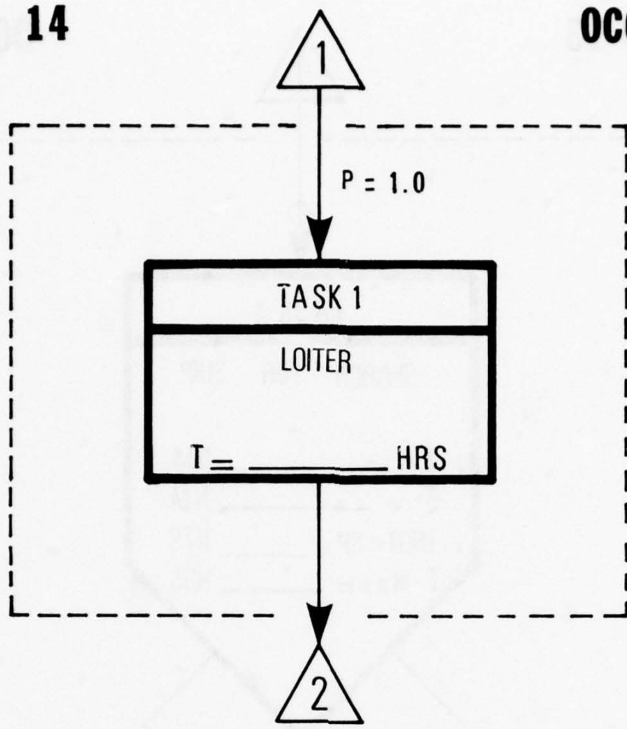


FIGURE A-14

STEAM GROUP

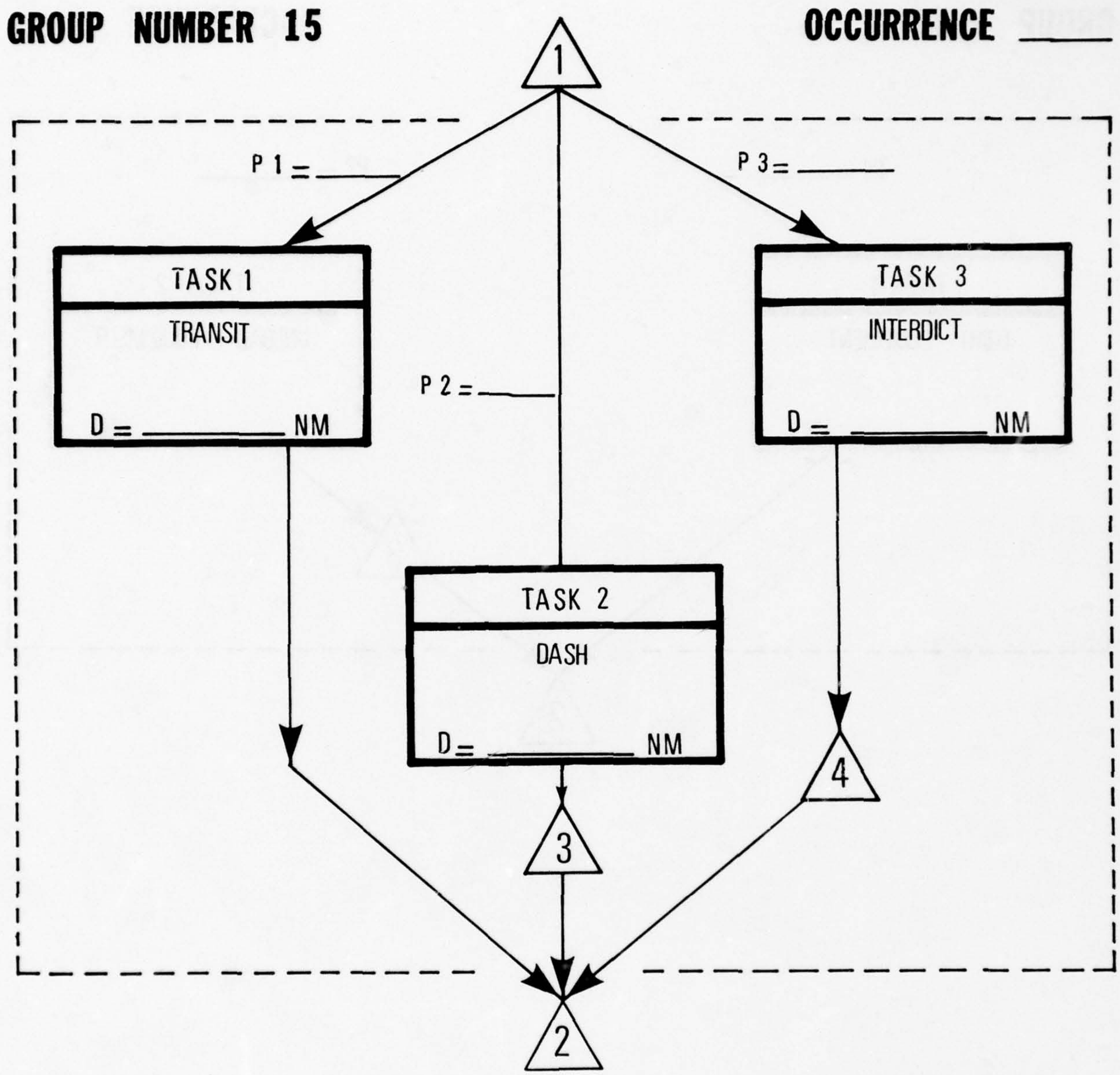


FIGURE A-15

TRANSFER EQUIPMENT GROUP

GROUP NUMBER 16 **OCCURRENCE _____**

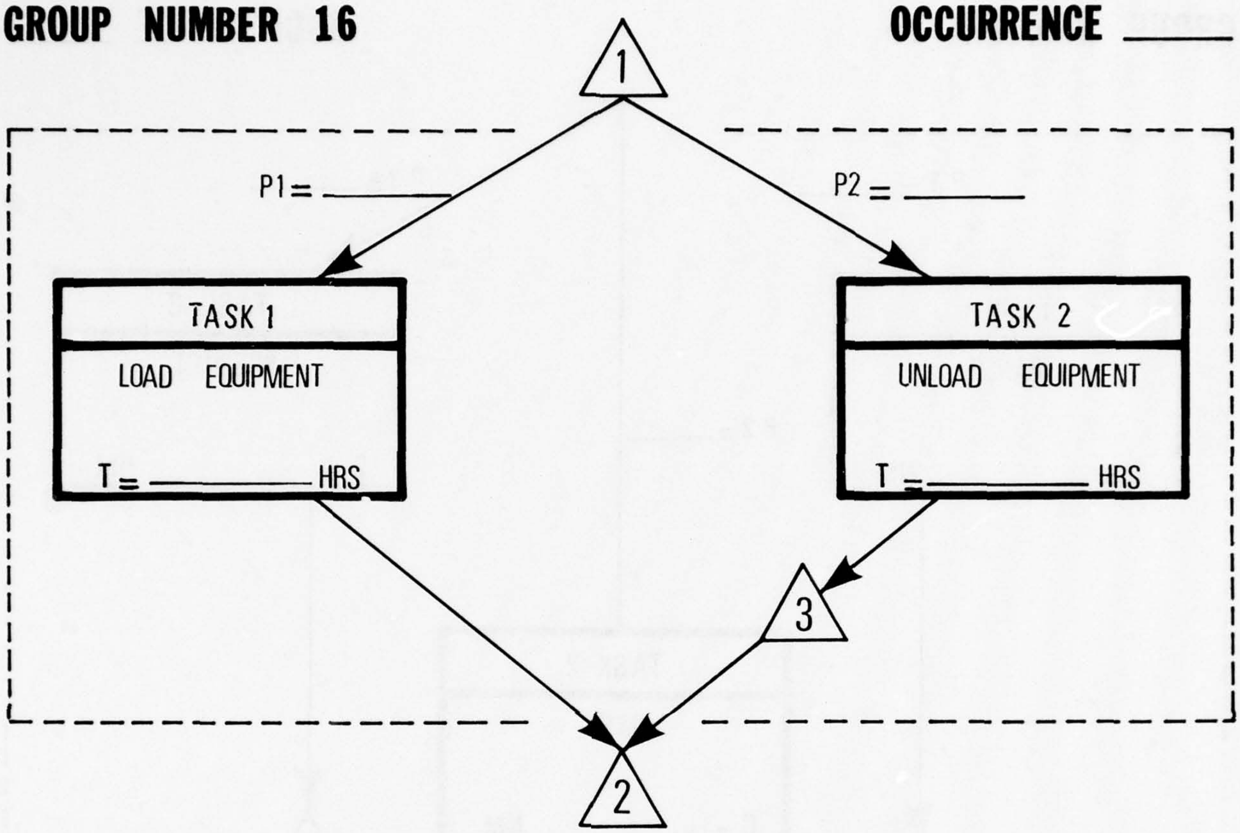


FIGURE A-16

TRANSPORT EQUIPMENT GROUP

GROUP NUMBER 17 **OCCURRENCE ____**

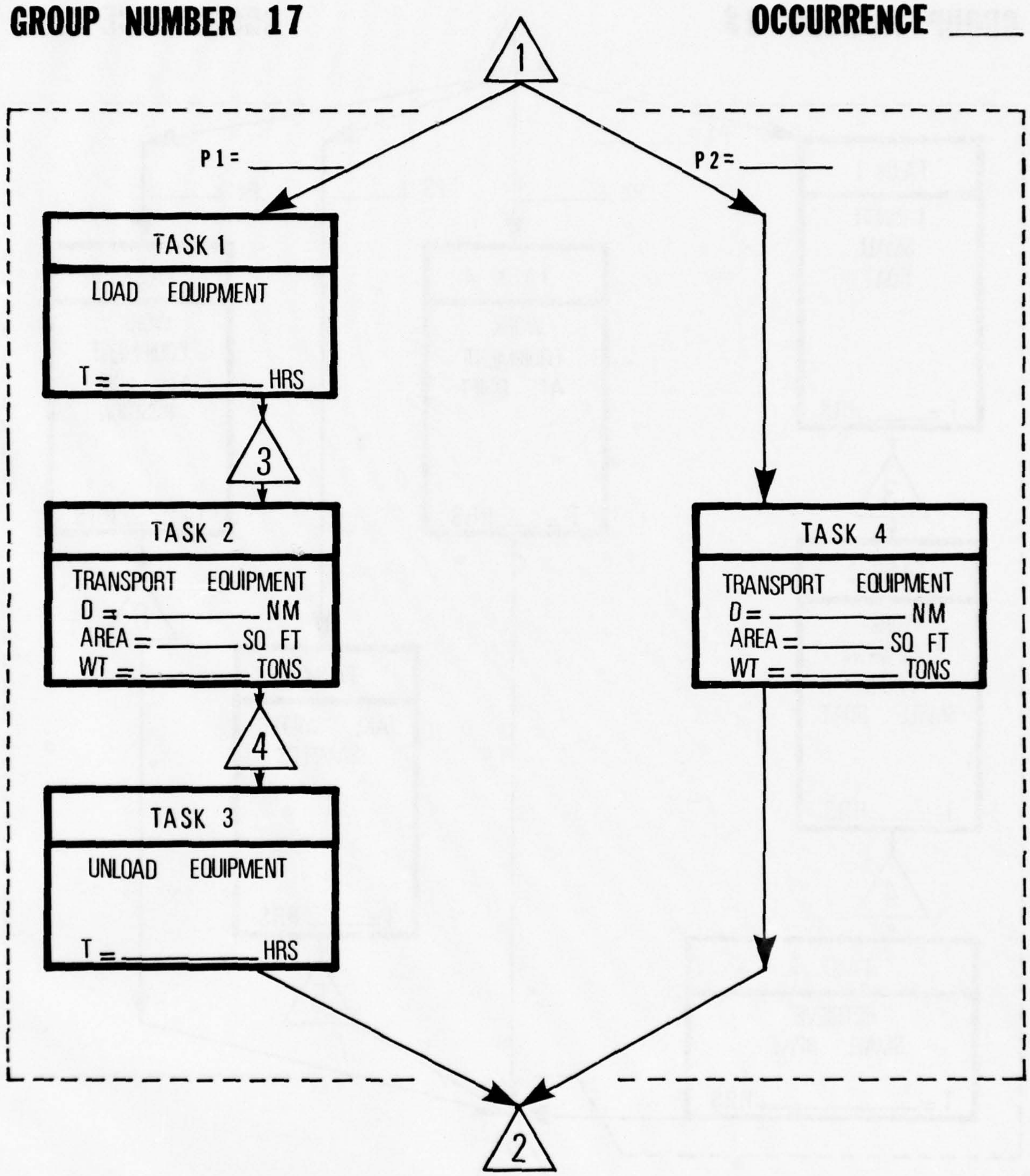


FIGURE A-17

WORK EQUIPMENT GROUP

GROUP NUMBER 18 **OCCURRENCE ____**

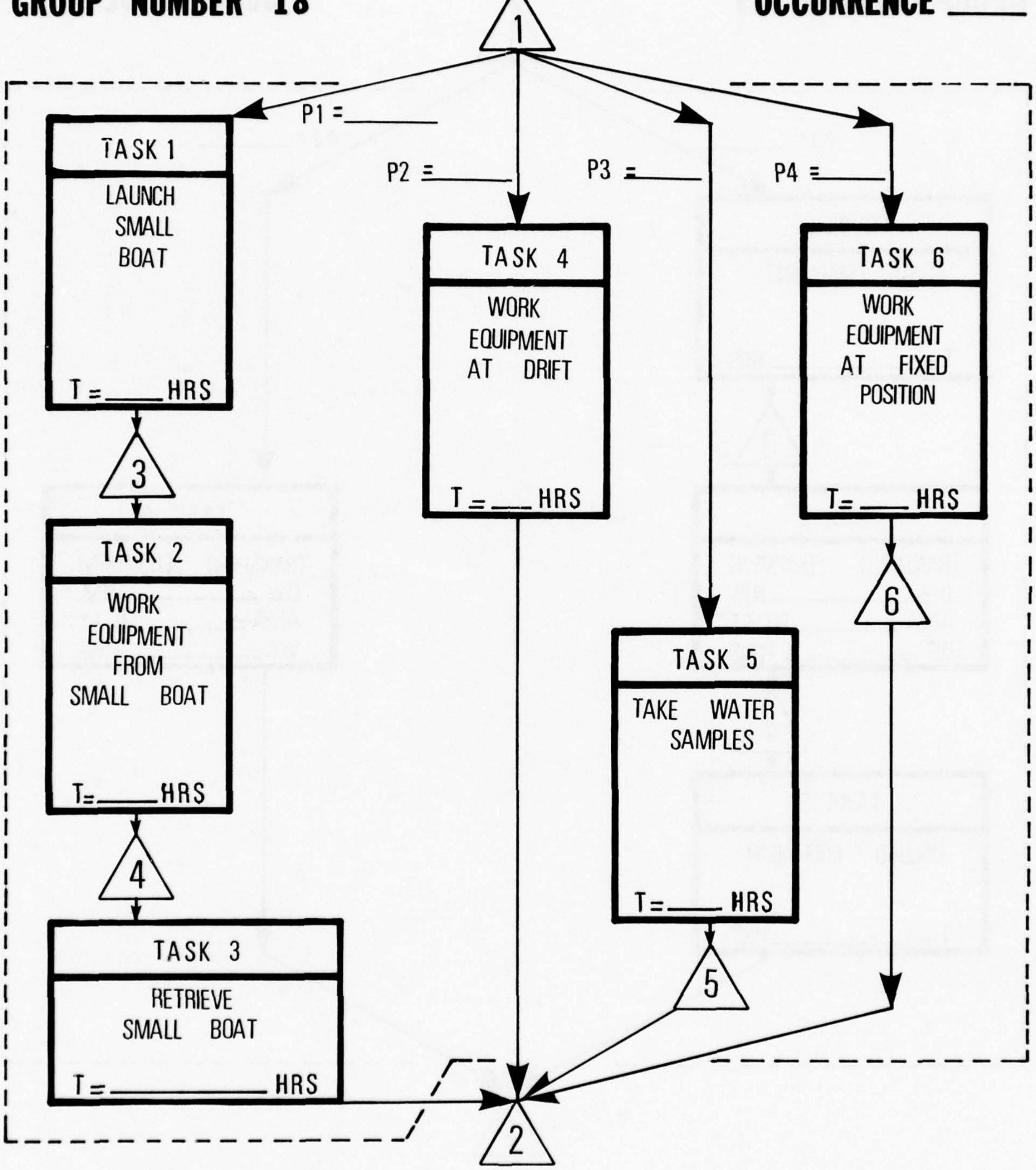
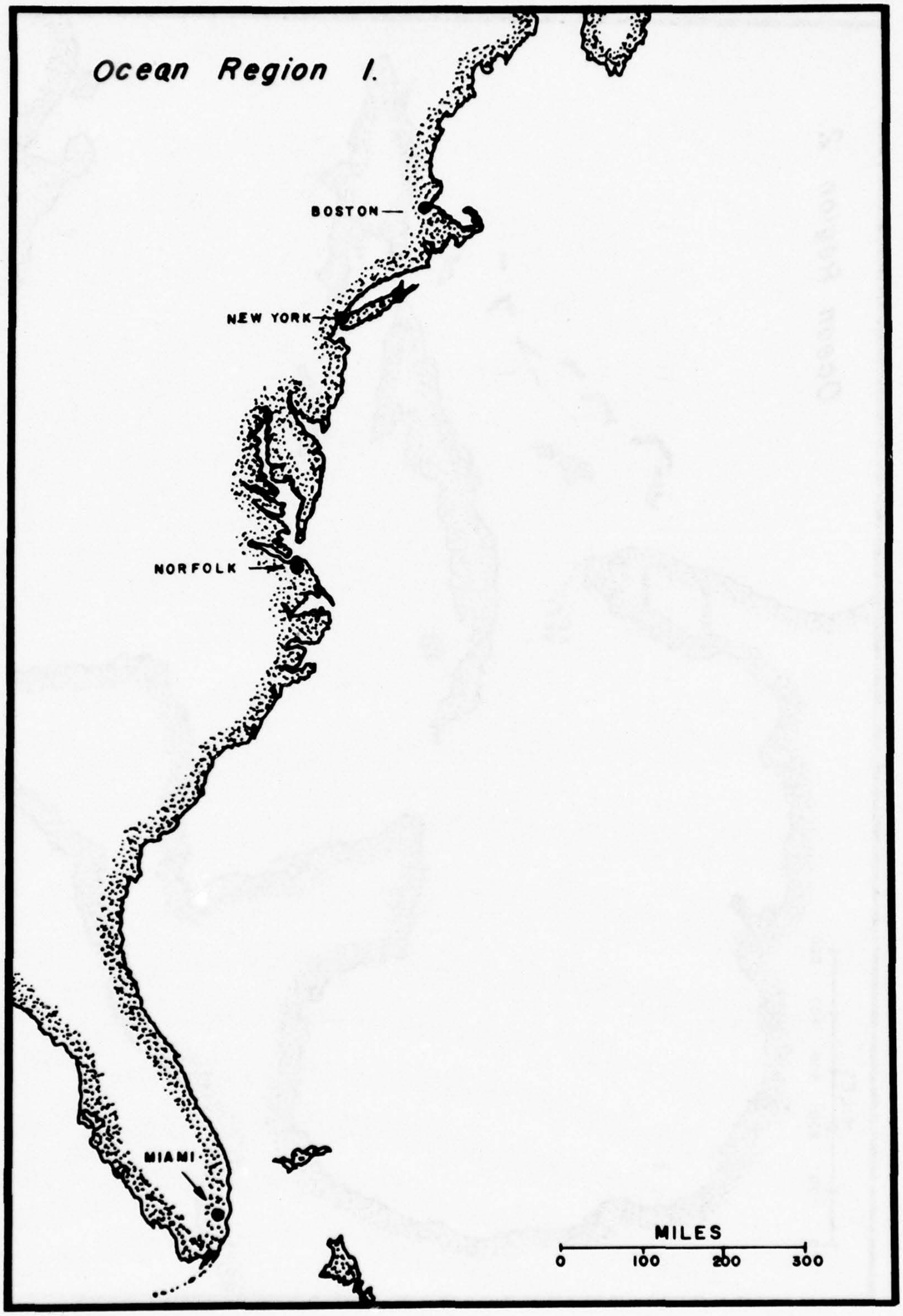
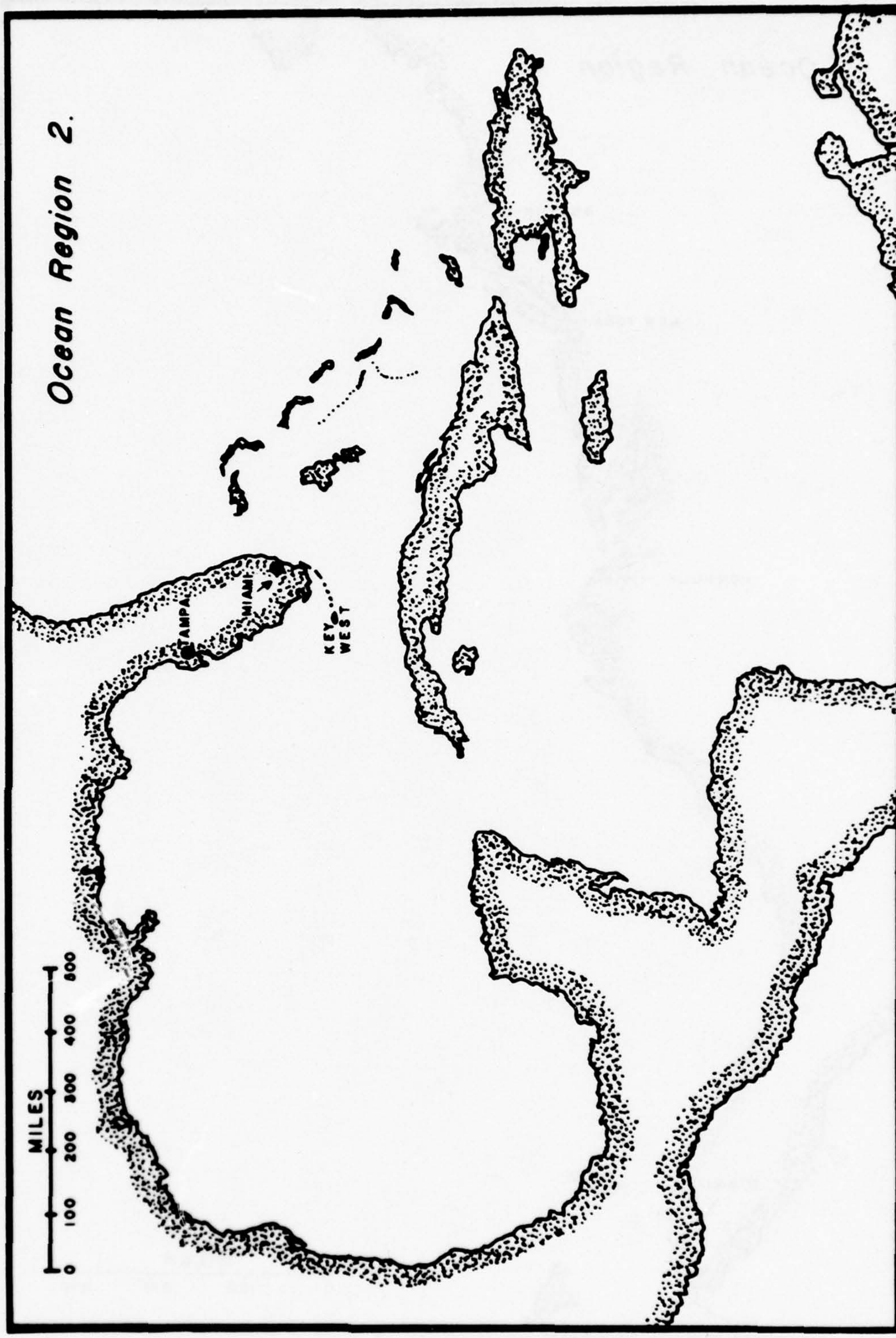


FIGURE A-18



Ocean Region I.
BOSTON
NEW YORK
NORFOLK
MIAMI
MILES
0
100
200
300

Figure B-1



Ocean Region 2.
MILES
0
100
200
300
400
500
TAMPA
MIAMI
KEY WEST

Figure B-2

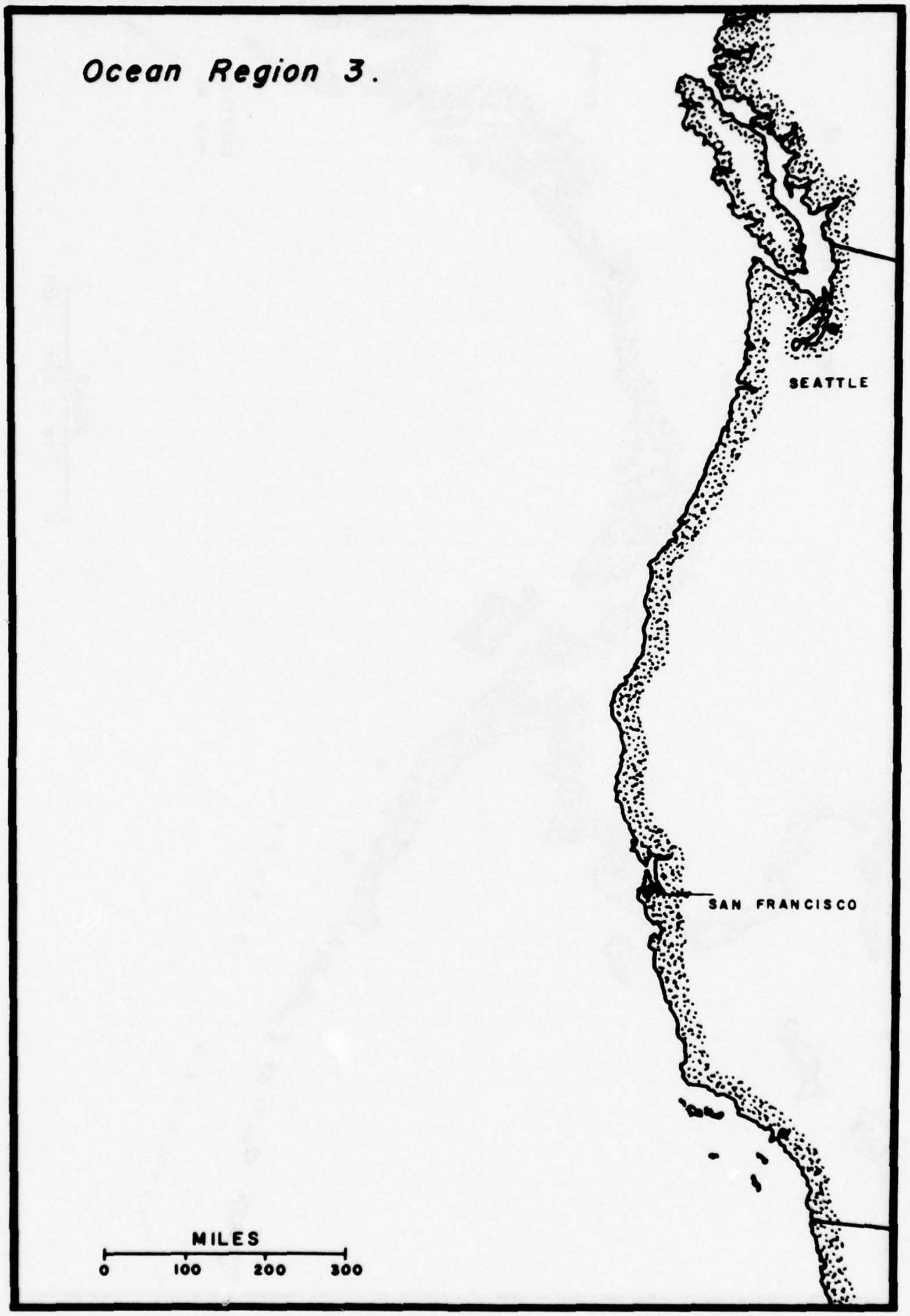
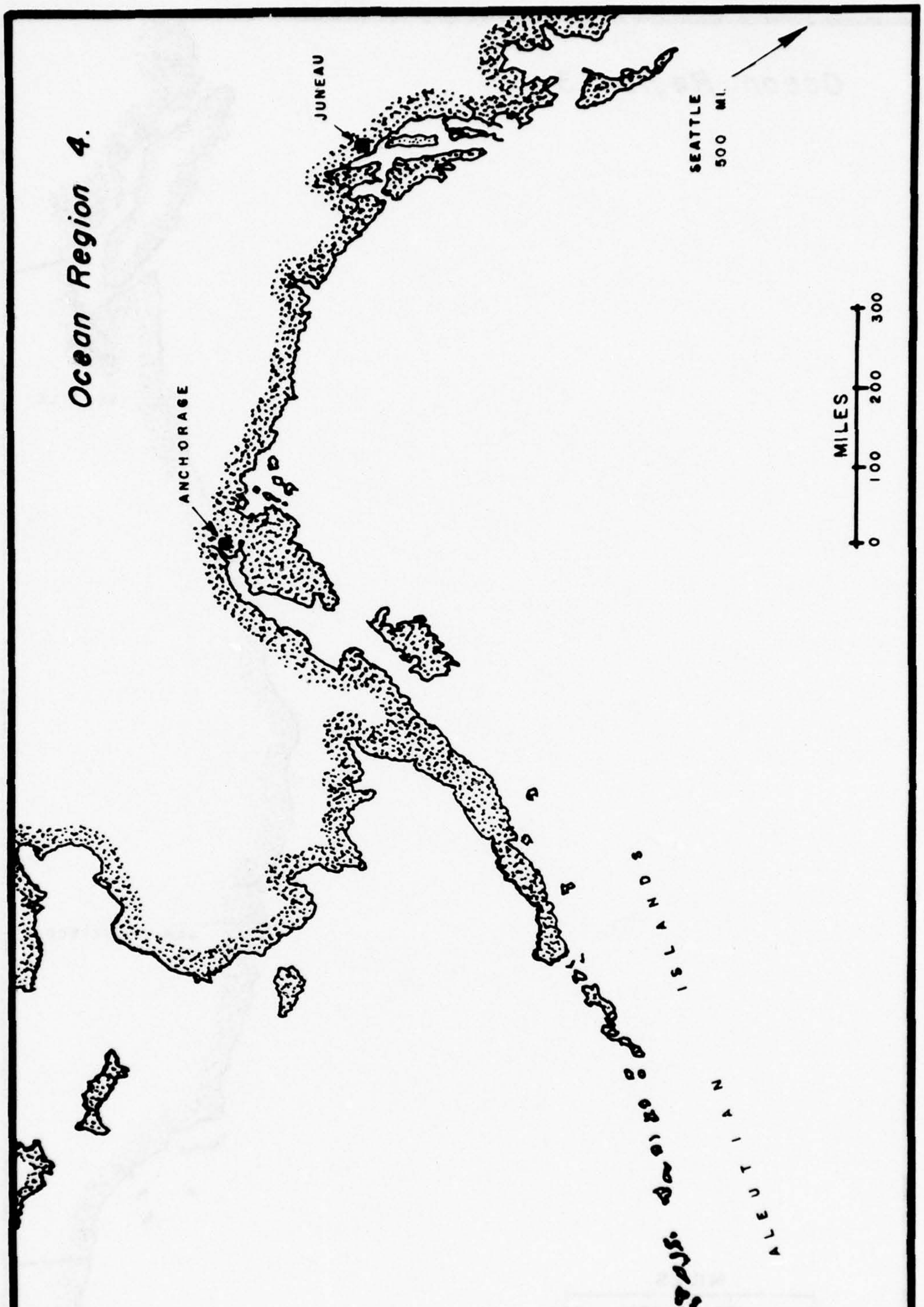


Figure B-3



Ocean Region 4.
JUNEAU
ANCHORAGE
SEATTLE
500 MI.
MILES
0
100
200
300
ALEUTIAN
ISLANDS

Figure B-4

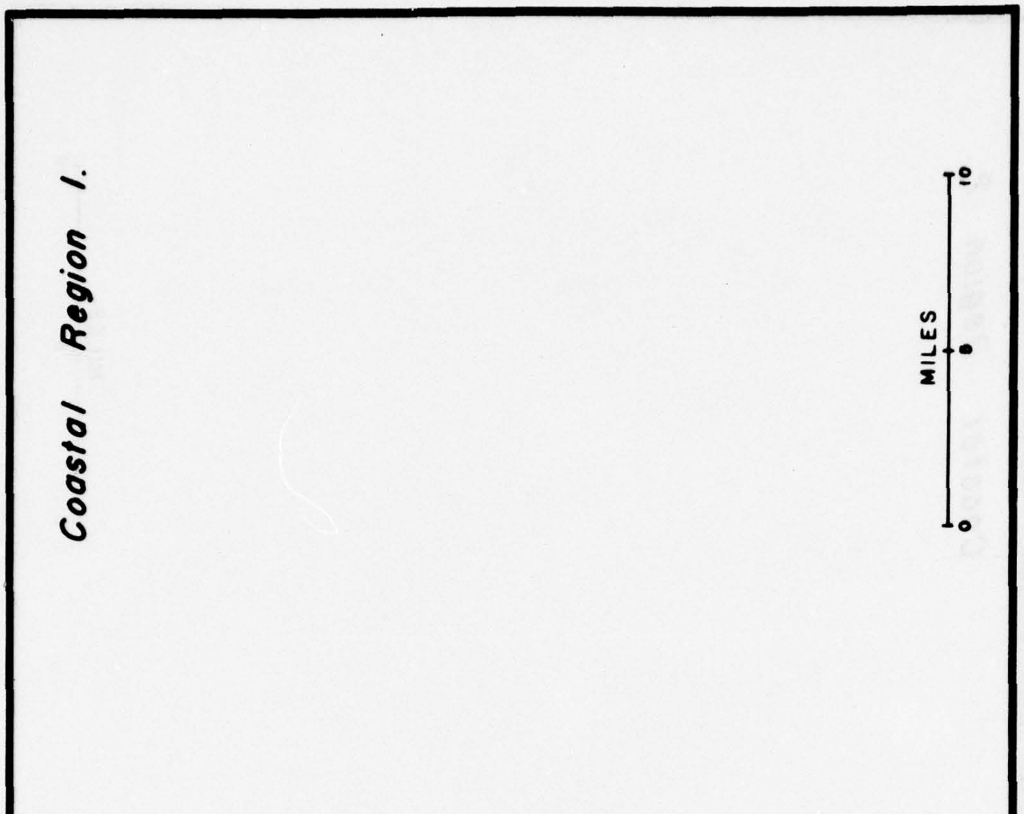


Figure B-5

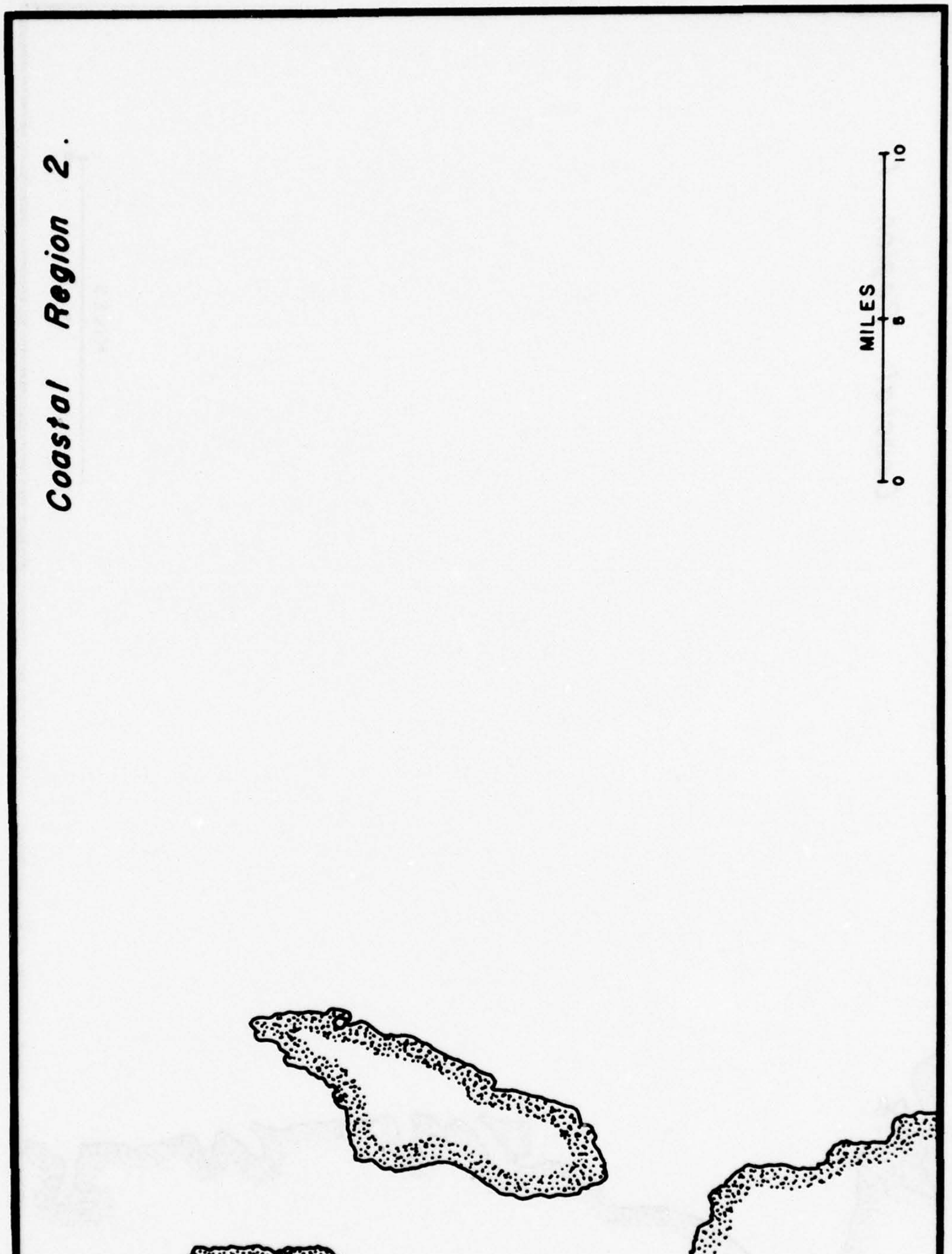


Figure B-6

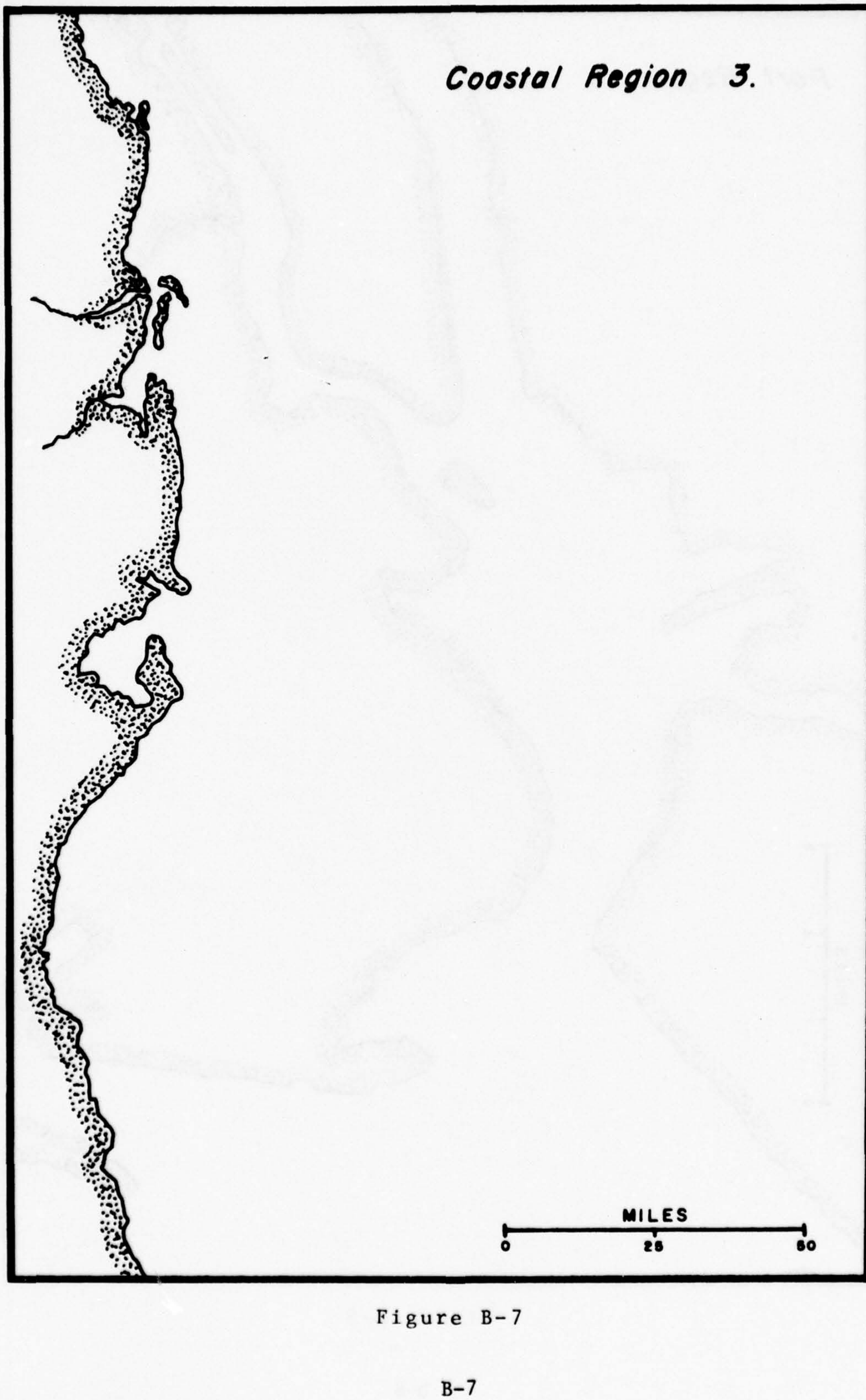


Figure B-7

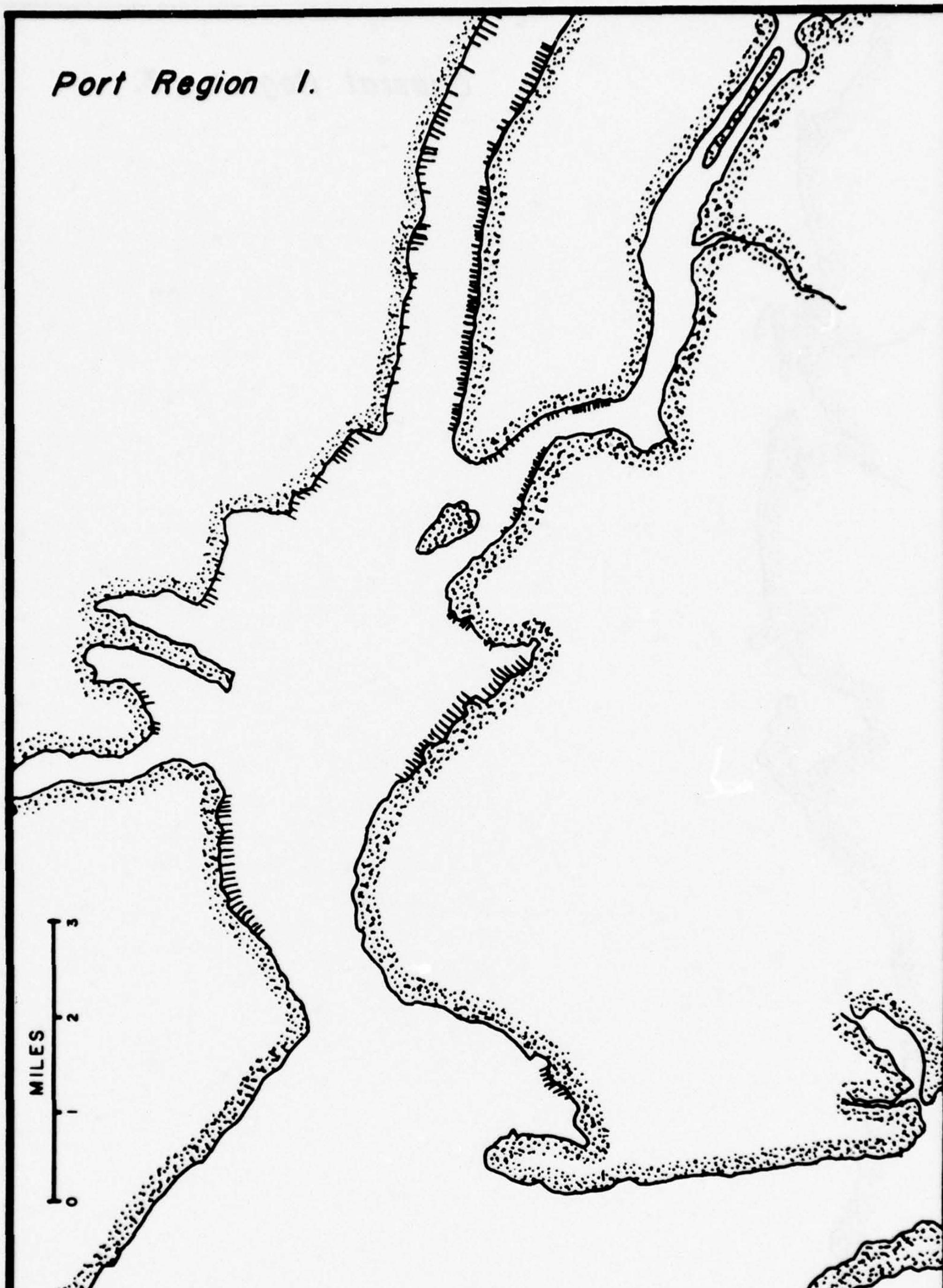


Figure B-8

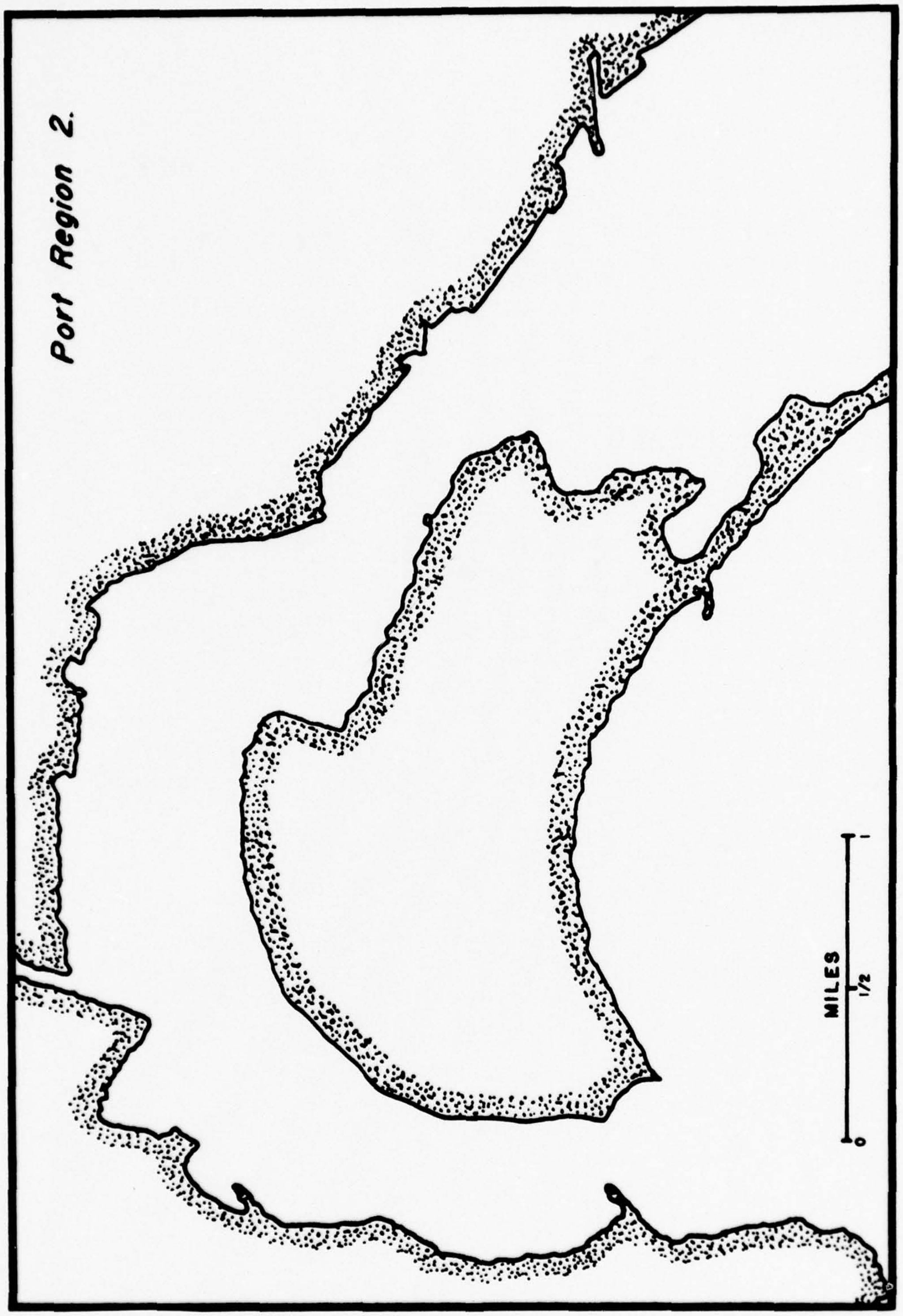


Figure B-9

TABLE C-1

SUMMARY OF SEA STATE PROBABILITY DISTRIBUTION

SS DISTRI-BUTION NUMBER	AVERAGE OF SEA STATE DISTRI-BUTION-SS	SEA STATE					
		0-1	1-2	2-3	3-4	4-5	5-6
1	0.5	1.0	0	0	0	0	0
2	1.0	.55	.40	.05	0	0	0
3	1.5	.20	.60	.15	.05	0	0
4	2.0	.20	.30	.35	.10	.05	0
5	2.5	.10	.30	.30	.15	.10	.05
6	3.0	.05	.15	.25	.40	.10	.05
7	3.5	.05	.10	.10	.35	.20	.15
8	4.0	0	.05	.15	.25	.35	.20
9	4.5	0	0	.05	.20	.45	.30
10	5.0	0	0	0	.10	.30	.60

SEA STATE DISTRIBUTION
NUMBER 1

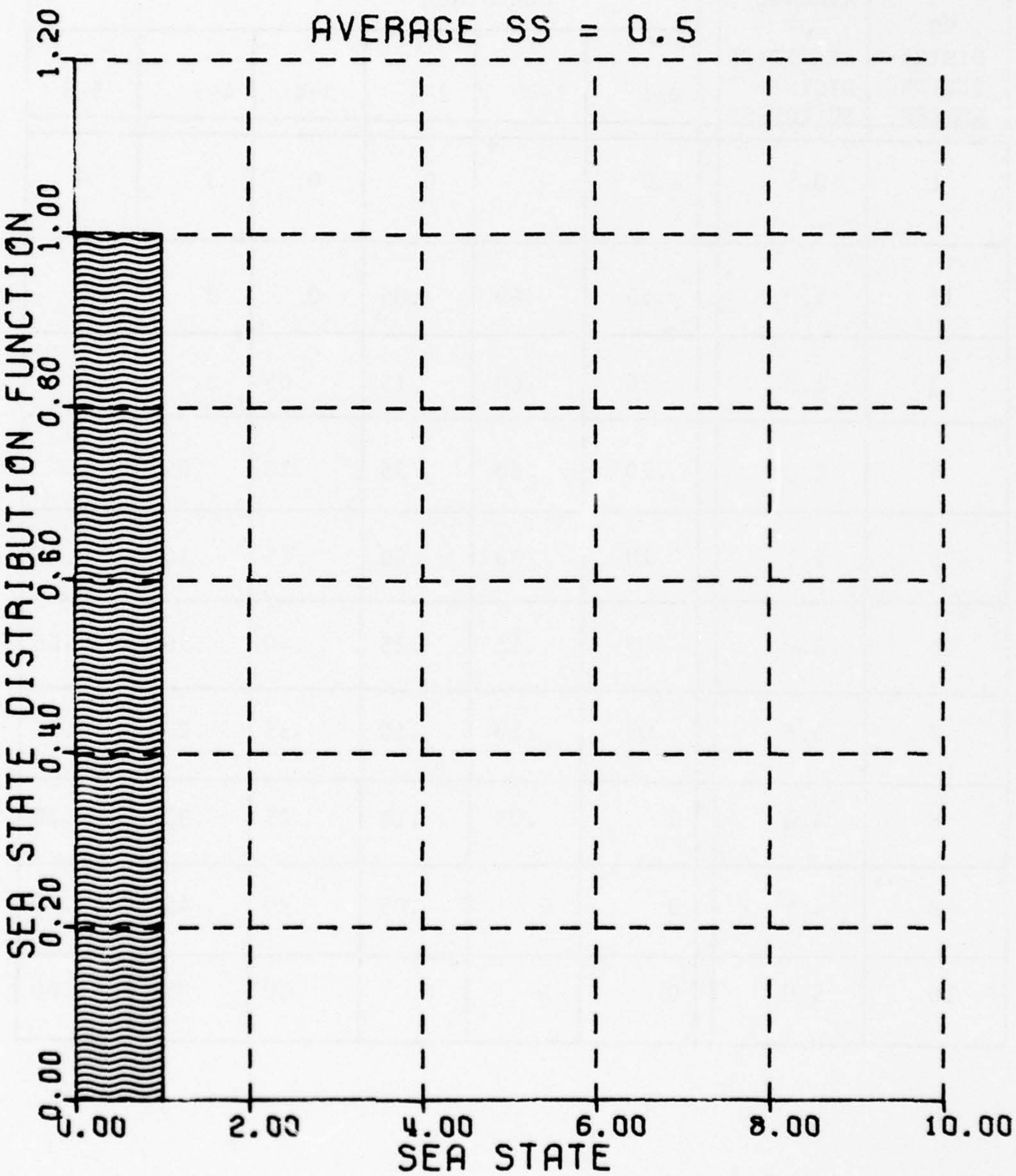


FIGURE C-1

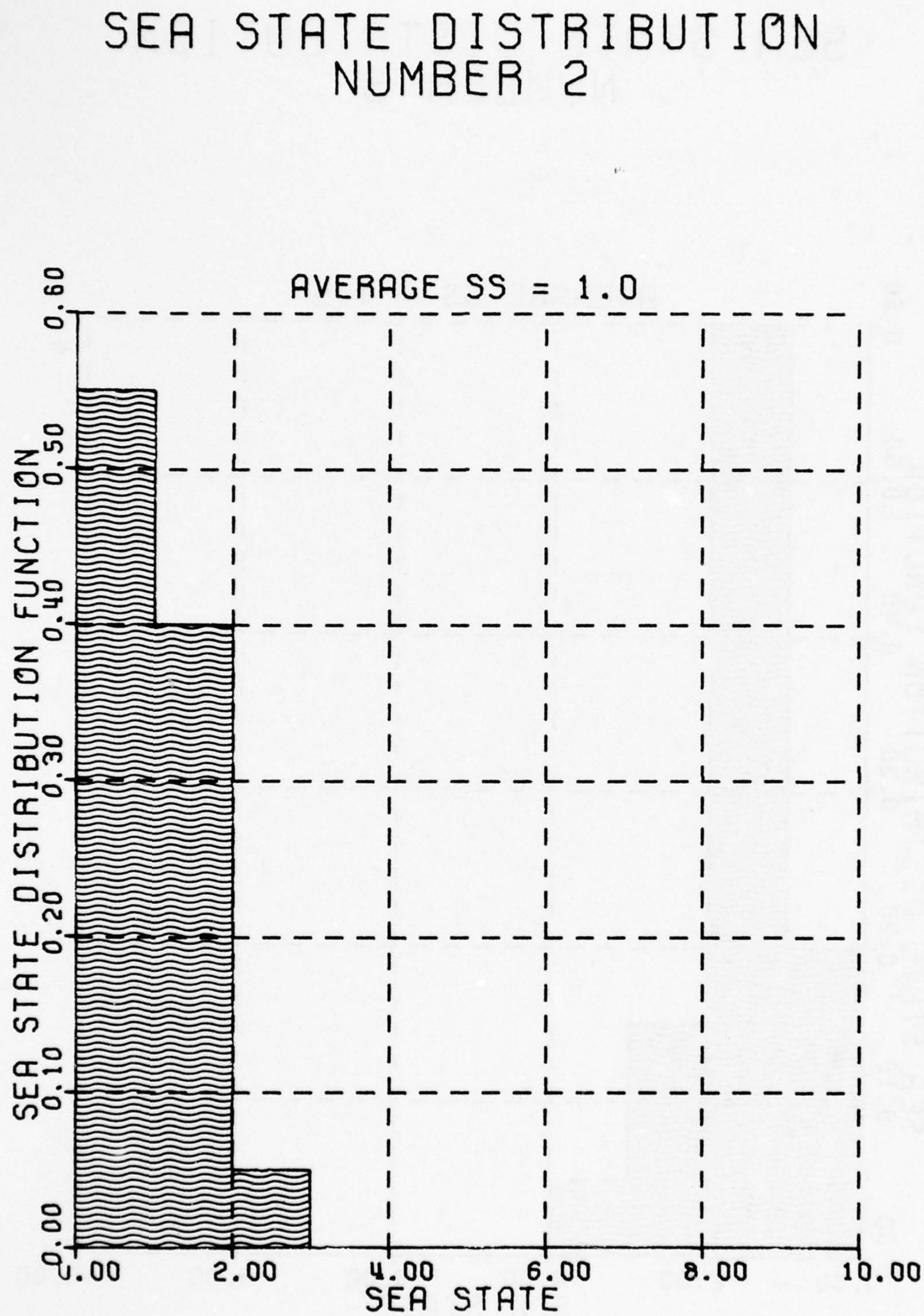

SEA STATE DISTRIBUTION
NUMBER 2
AVERAGE SS = 1.0
SEA STATE DISTRIBUTION FUNCTION
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.00
2.00
4.00
6.00
8.00
10.00
SEA STATE

FIGURE C-2

SEA STATE DISTRIBUTION
NUMBER 3

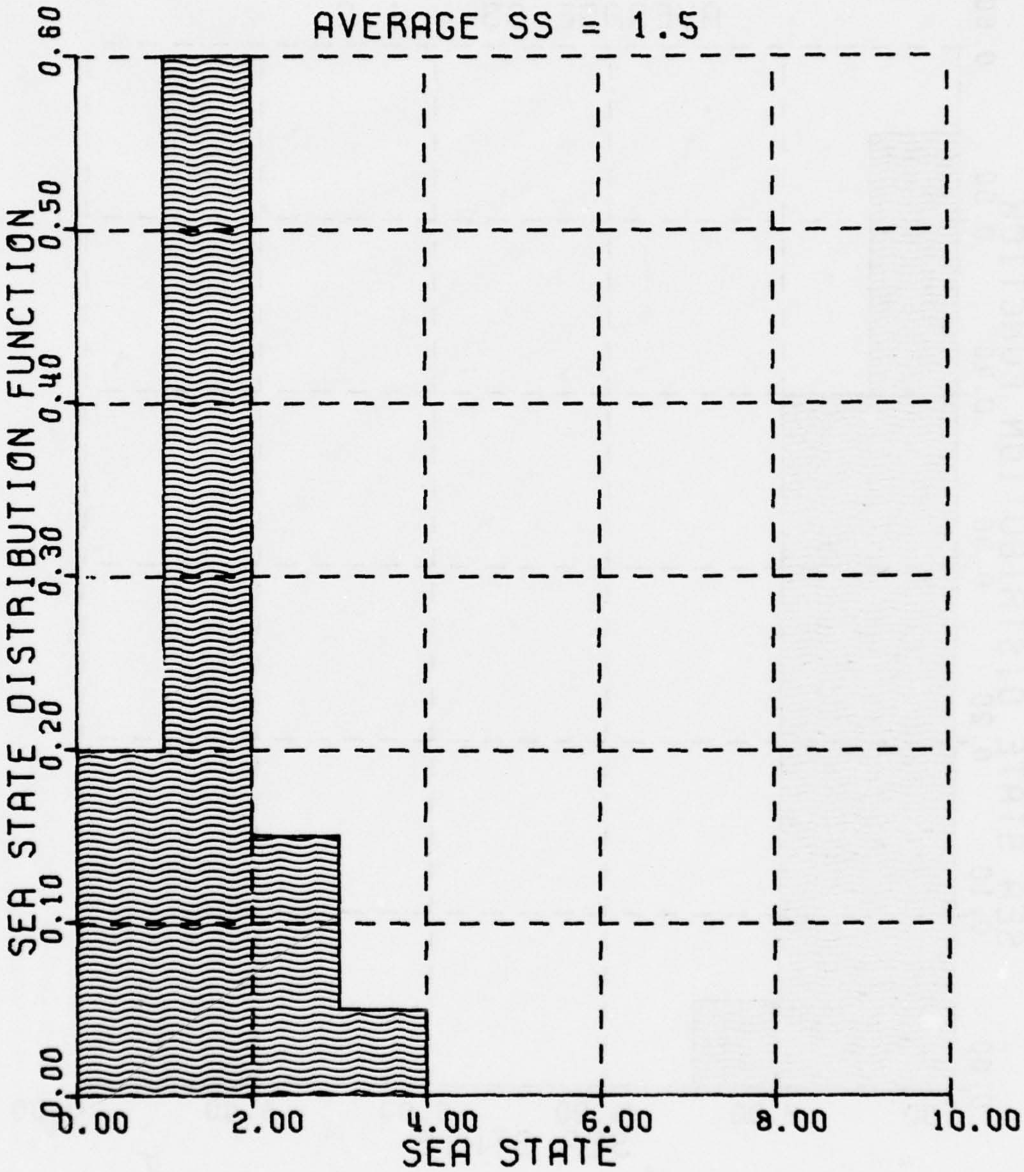


FIGURE C-3

SEA STATE DISTRIBUTION
NUMBER 4

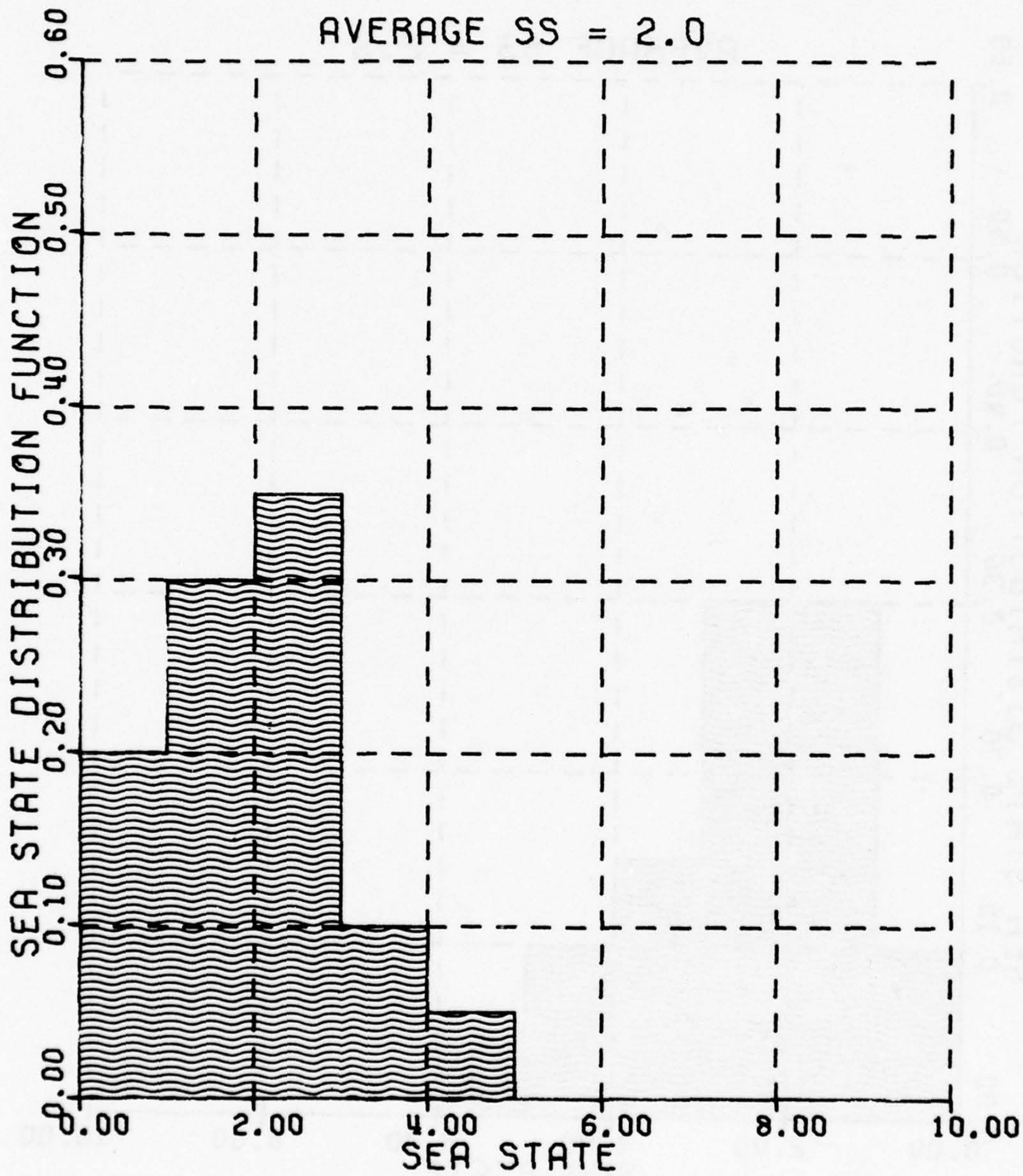


FIGURE C-4

SEA STATE DISTRIBUTION
NUMBER 5

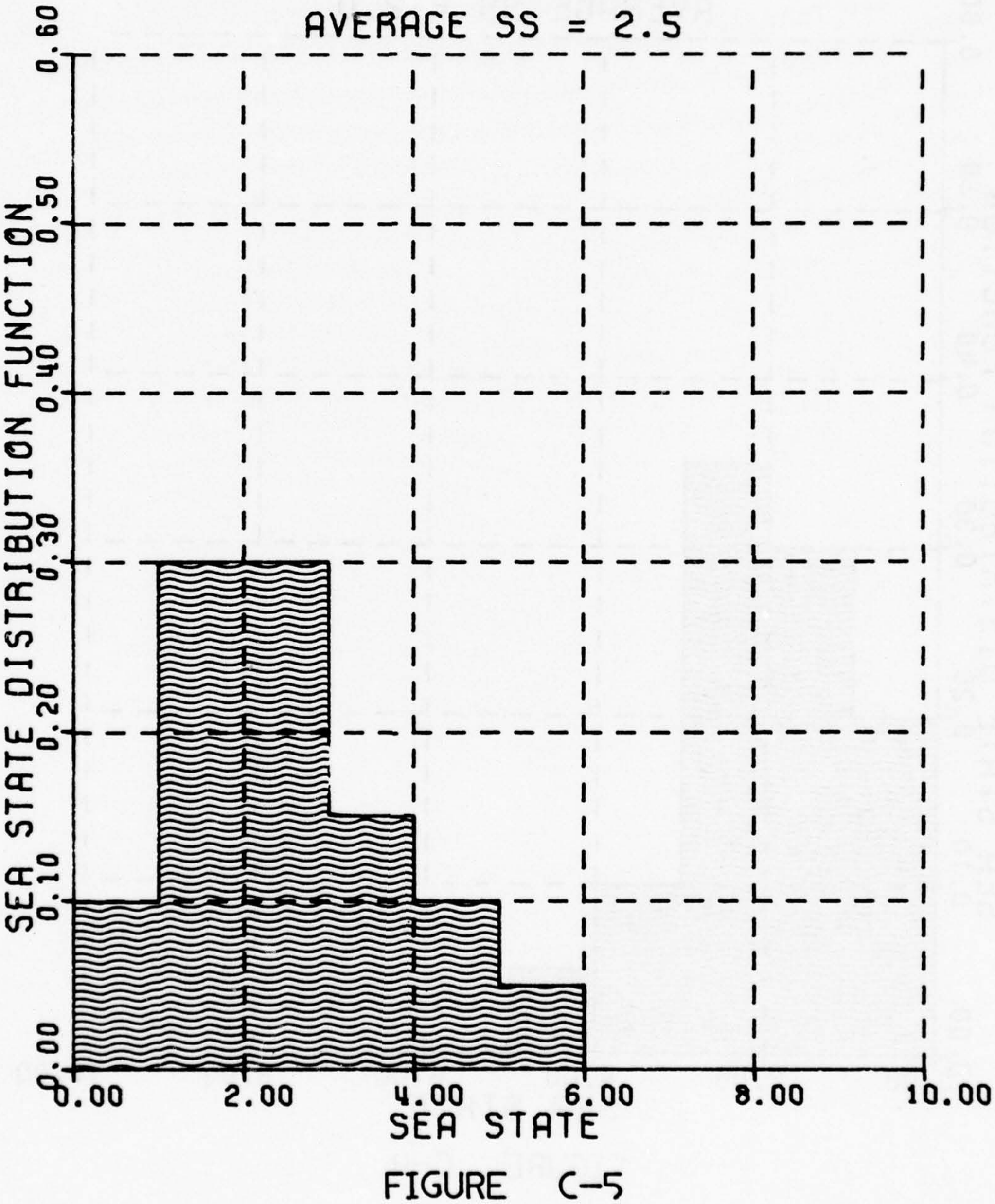


FIGURE C-5

SEA STATE DISTRIBUTION NUMBER 6

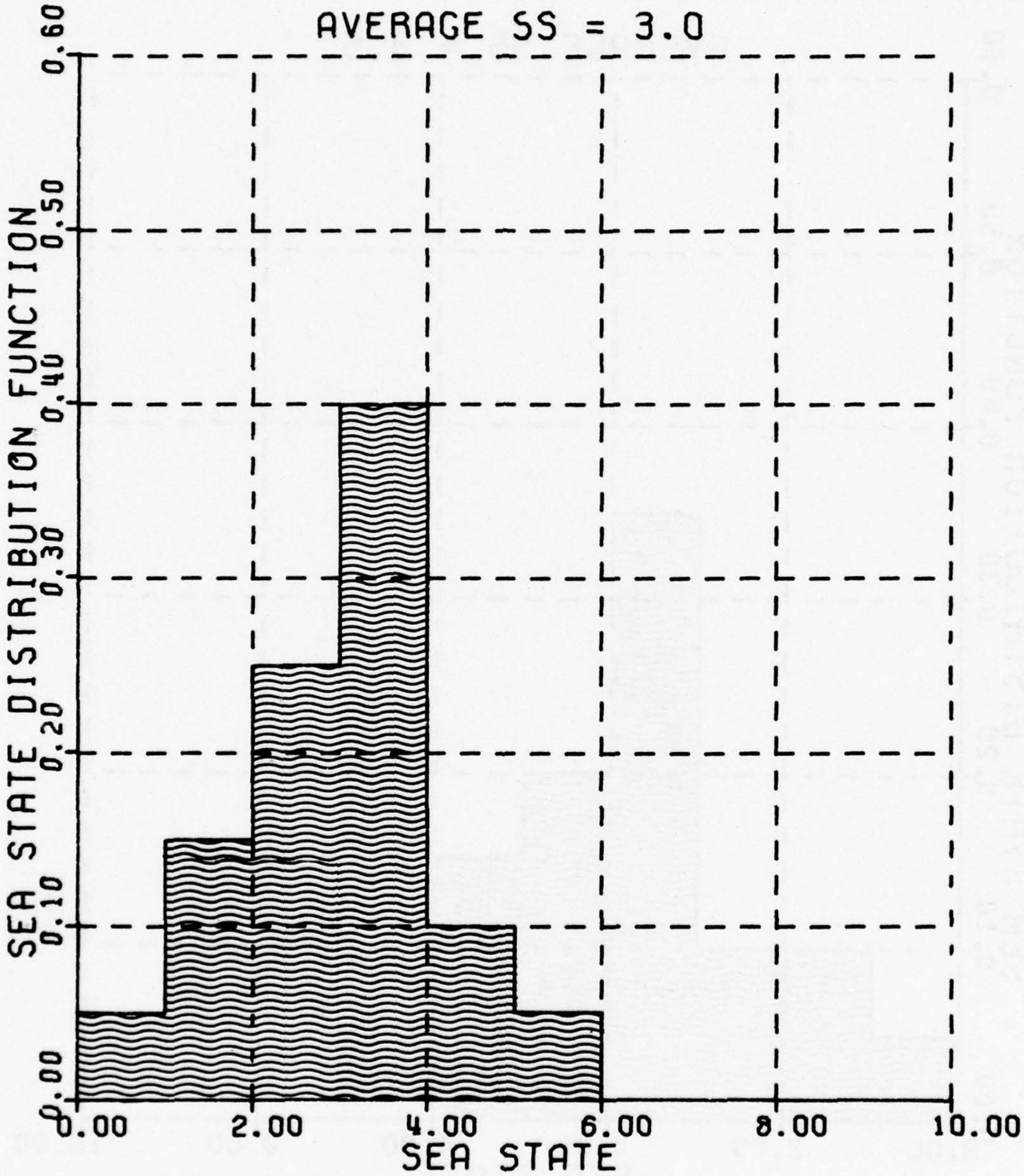


FIGURE C-6

SEA STATE DISTRIBUTION NUMBER 7

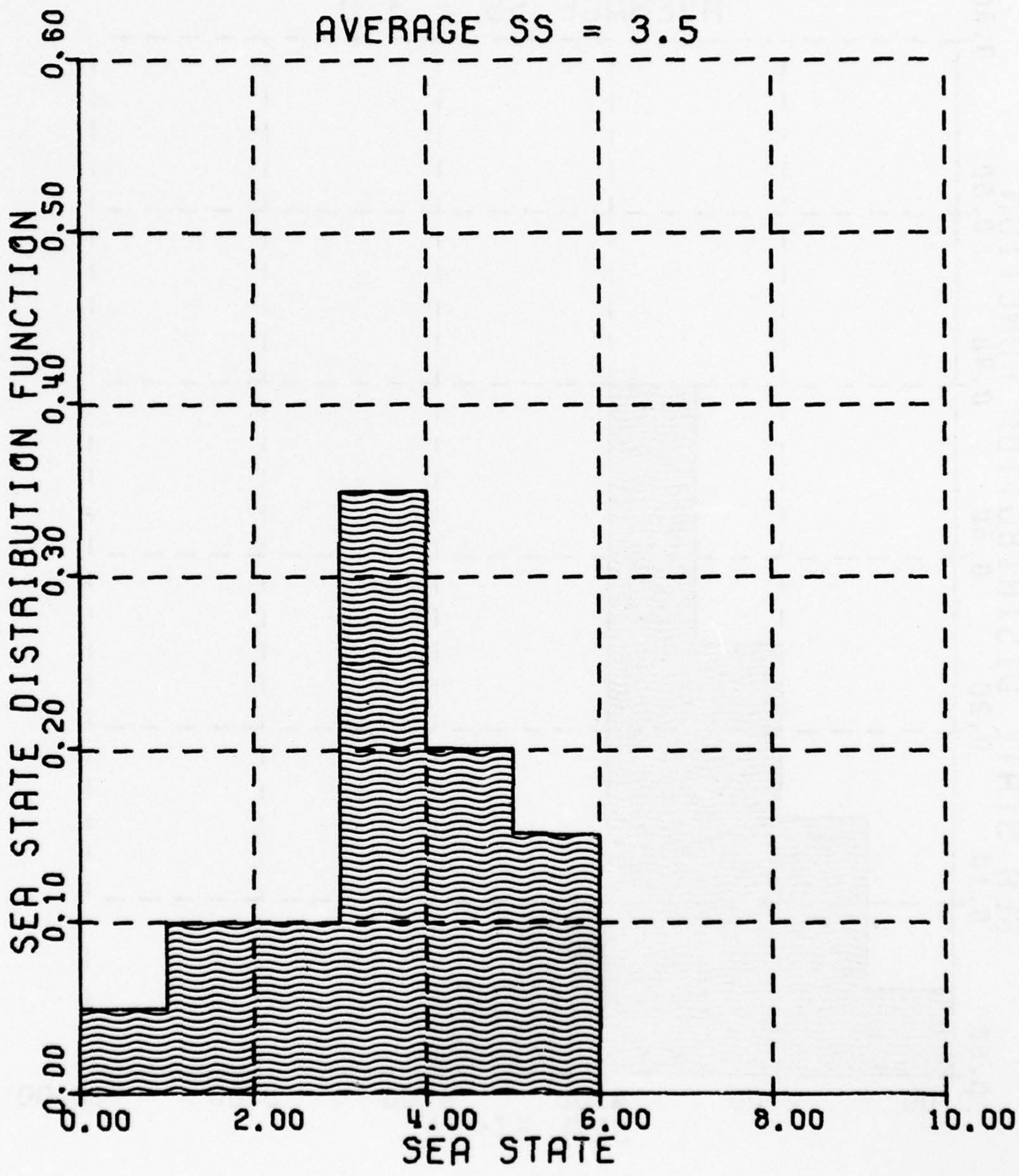


FIGURE C-7

SEA STATE DISTRIBUTION
NUMBER 8

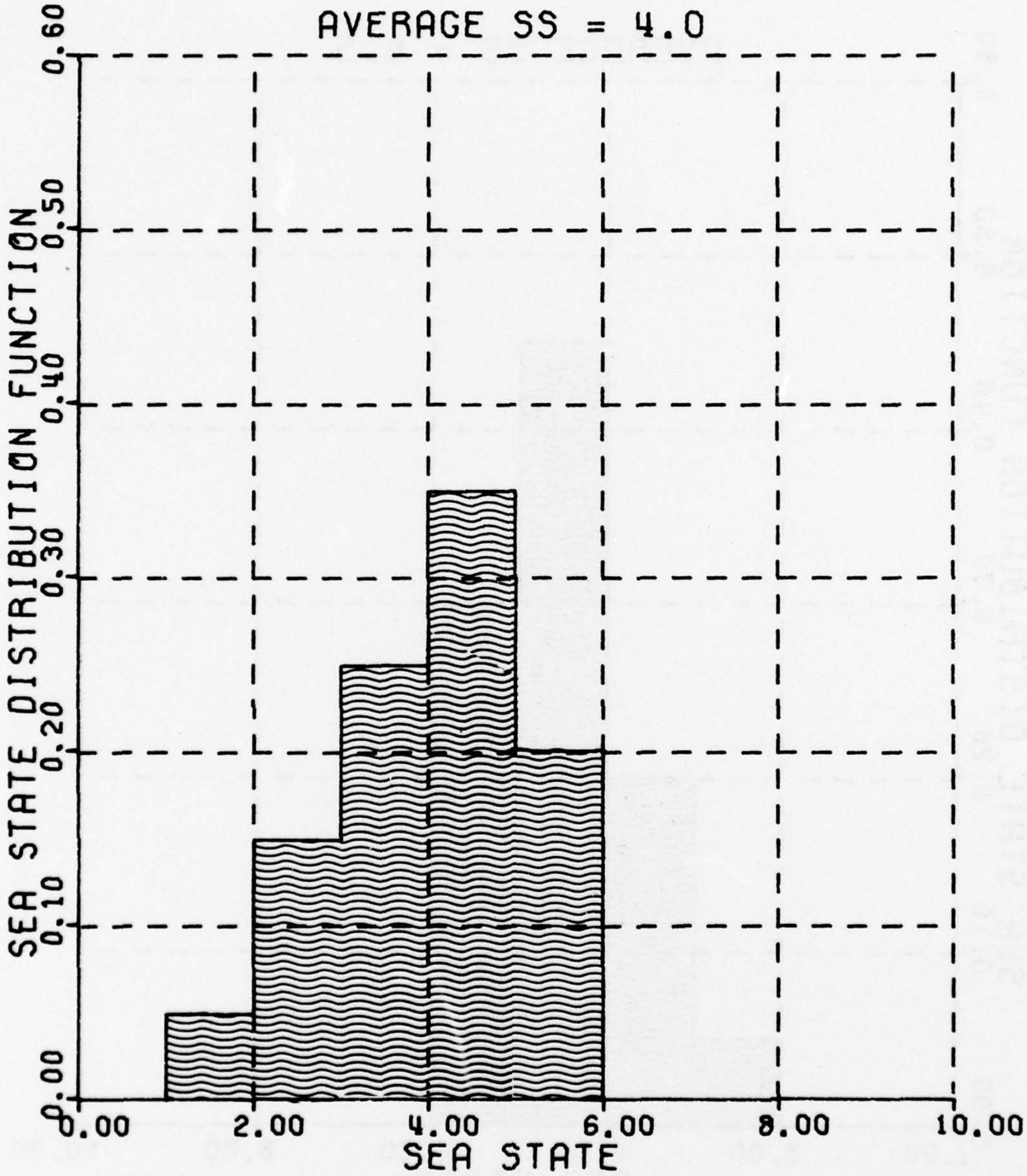


FIGURE C-8

SEA STATE DISTRIBUTION
NUMBER 9

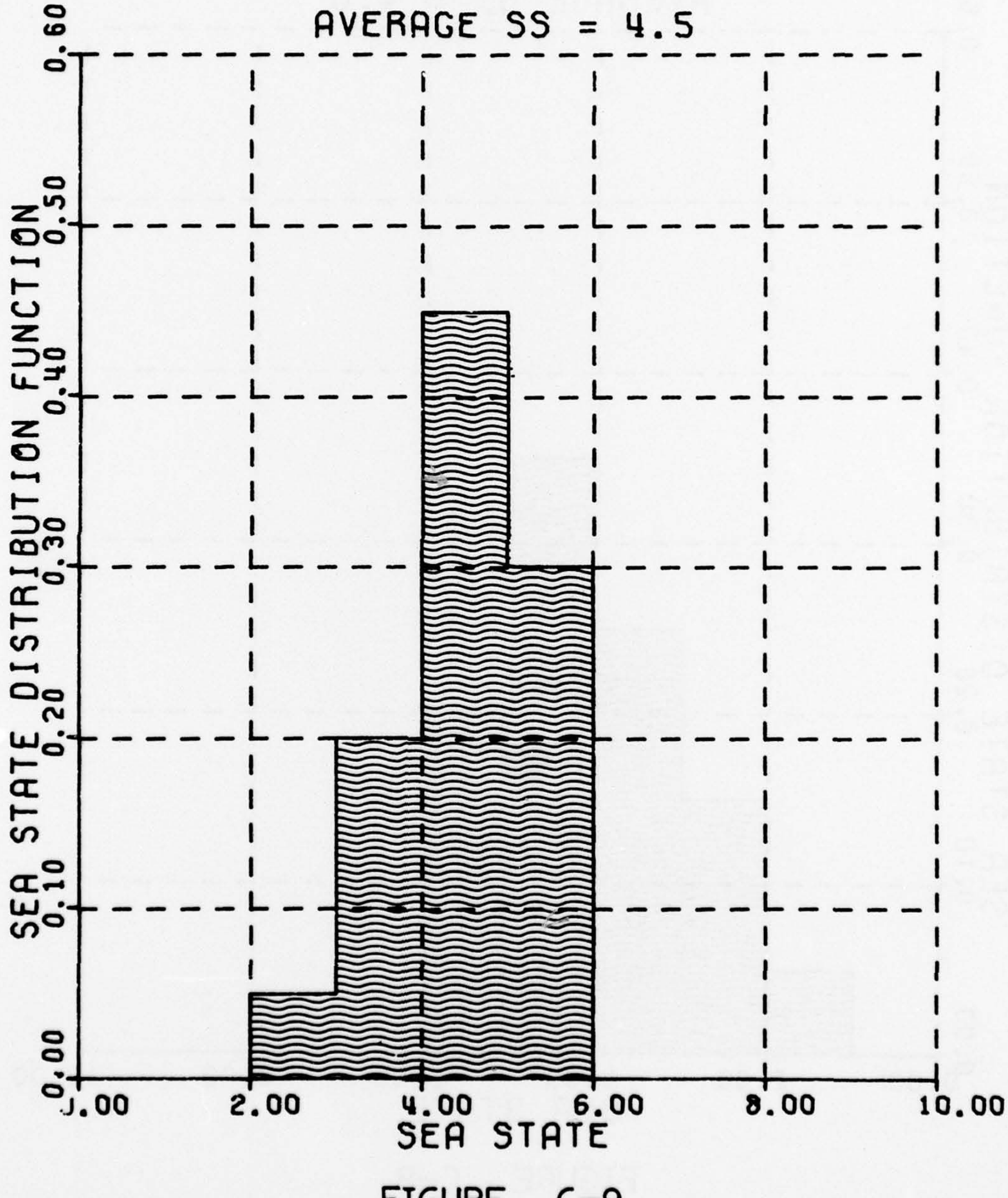


FIGURE C-9

SEA STATE DISTRIBUTION
NUMBER 10

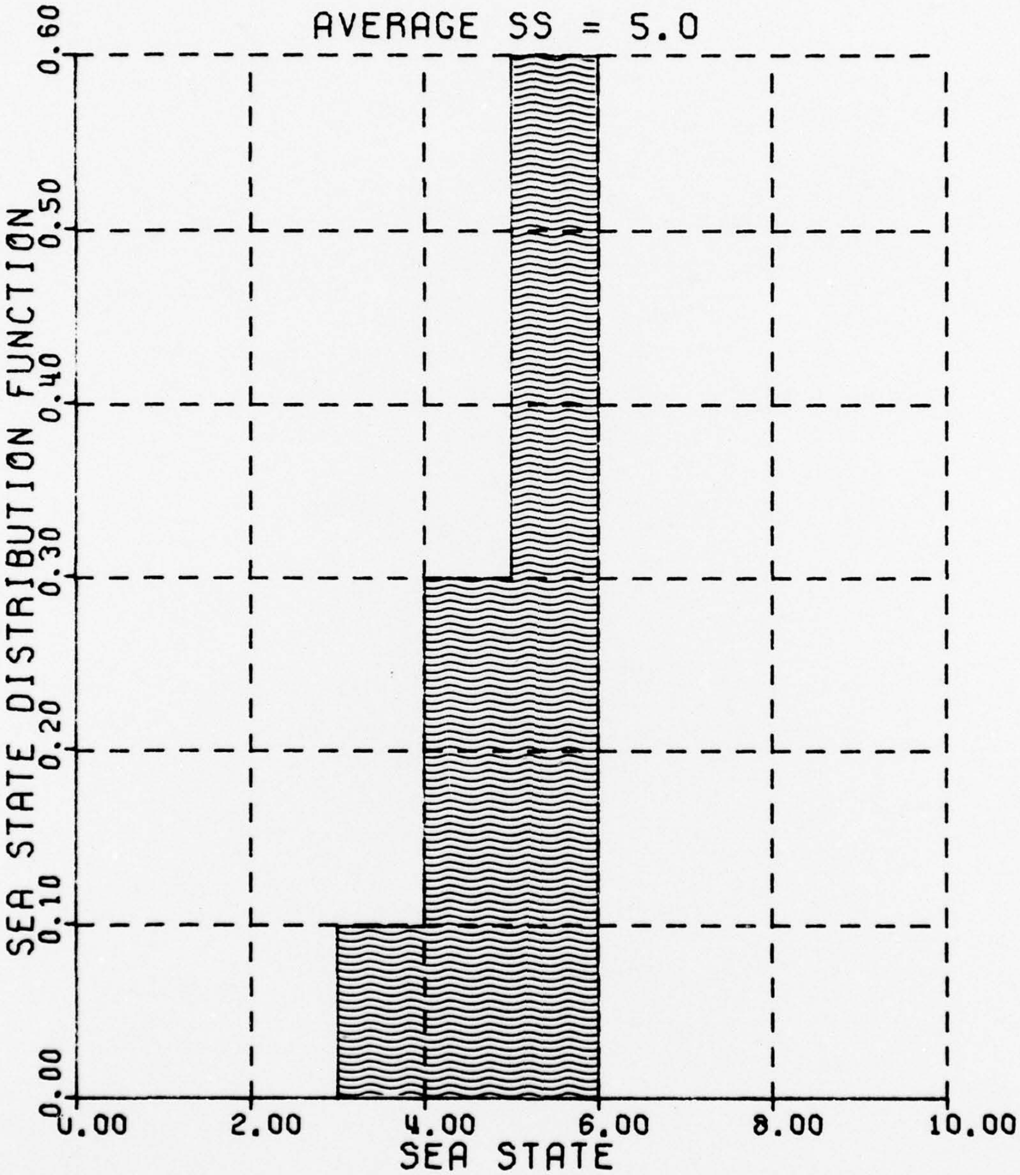


FIGURE C-10

TABLE D-1

VISIBILITY PROBABILITY DISTRIBUTION

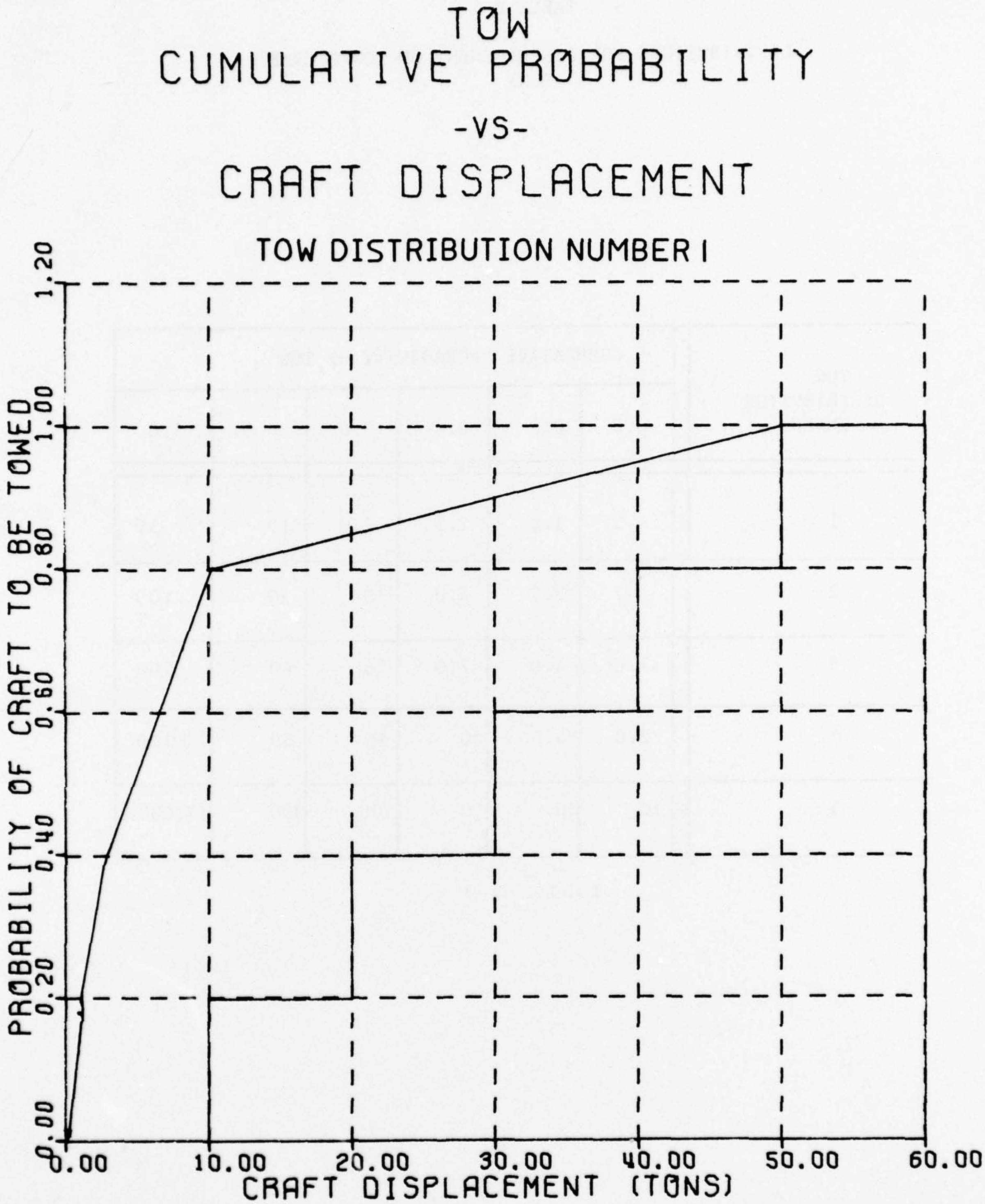
DISTRIBUTION NUMBER DESCRIPTION		GOOD	FAIR	POOR
1	Very Good	0.9	0.1	0
2	Good	0.7	0.2	0.1
3	Good to Fair	0.5	0.3	0.2

TABLE E-1

DISTRIBUTIONS FOR DISPLACEMENT OF TOWED CRAFT
TONS

TOW DISTRIBUTION NUMBER	CUMULATIVE PROBABILITY OF TOW					
	0.0	0.2	0.4	0.6	0.8	1.0
1	.5	1.0	2.5	7.0	10	50
2	.7	2.0	4.0	10	30	100
3	1.0	4.0	7.0	20	60	500
4	2.0	6.0	20	50	80	1000
5	10	20	50	100	300	10,000

Table E-1



TOW
CUMULATIVE PROBABILITY
-VS-
CRAFT DISPLACEMENT
TOW DISTRIBUTION NUMBER I
PROBABILITY OF CRAFT TO BE TOWED
0.00
0.20
0.40
0.60
0.80
1.00
1.20
0.00
10.00
20.00
30.00
40.00
50.00
60.00
CRAFT DISPLACEMENT (TONS)

FIGURE E-1

TOW
CUMULATIVE PROBABILITY
-VS-
CRAFT DISPLACEMENT

TOW DISTRIBUTION NUMBER 2

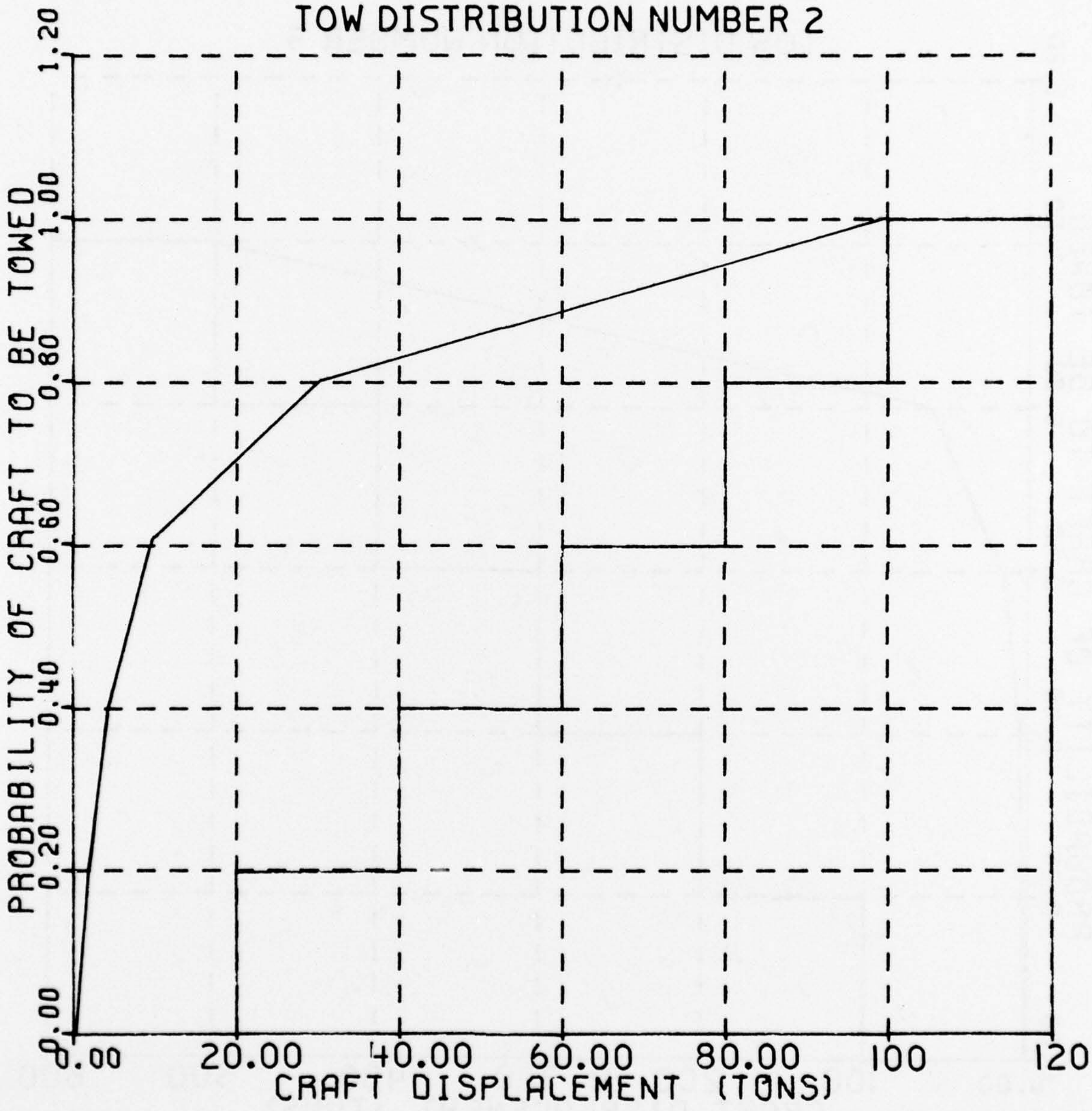


FIGURE E-2

TOW
CUMULATIVE PROBABILITY
-VS-
CRAFT DISPLACEMENT

TOW DISTRIBUTION NUMBER 3

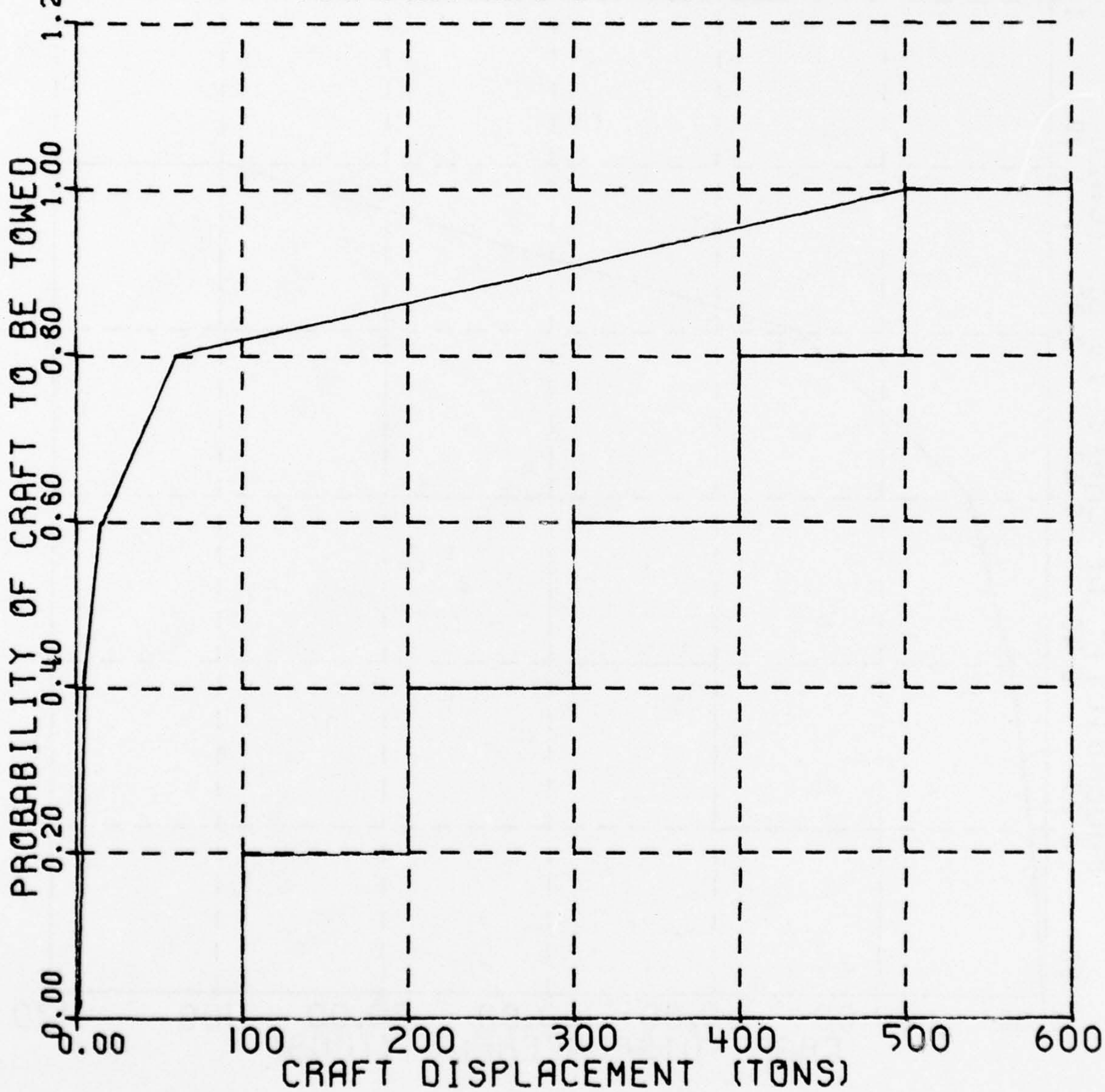


FIGURE E-3

TOW
CUMULATIVE PROBABILITY
-VS-
CRAFT DISPLACEMENT

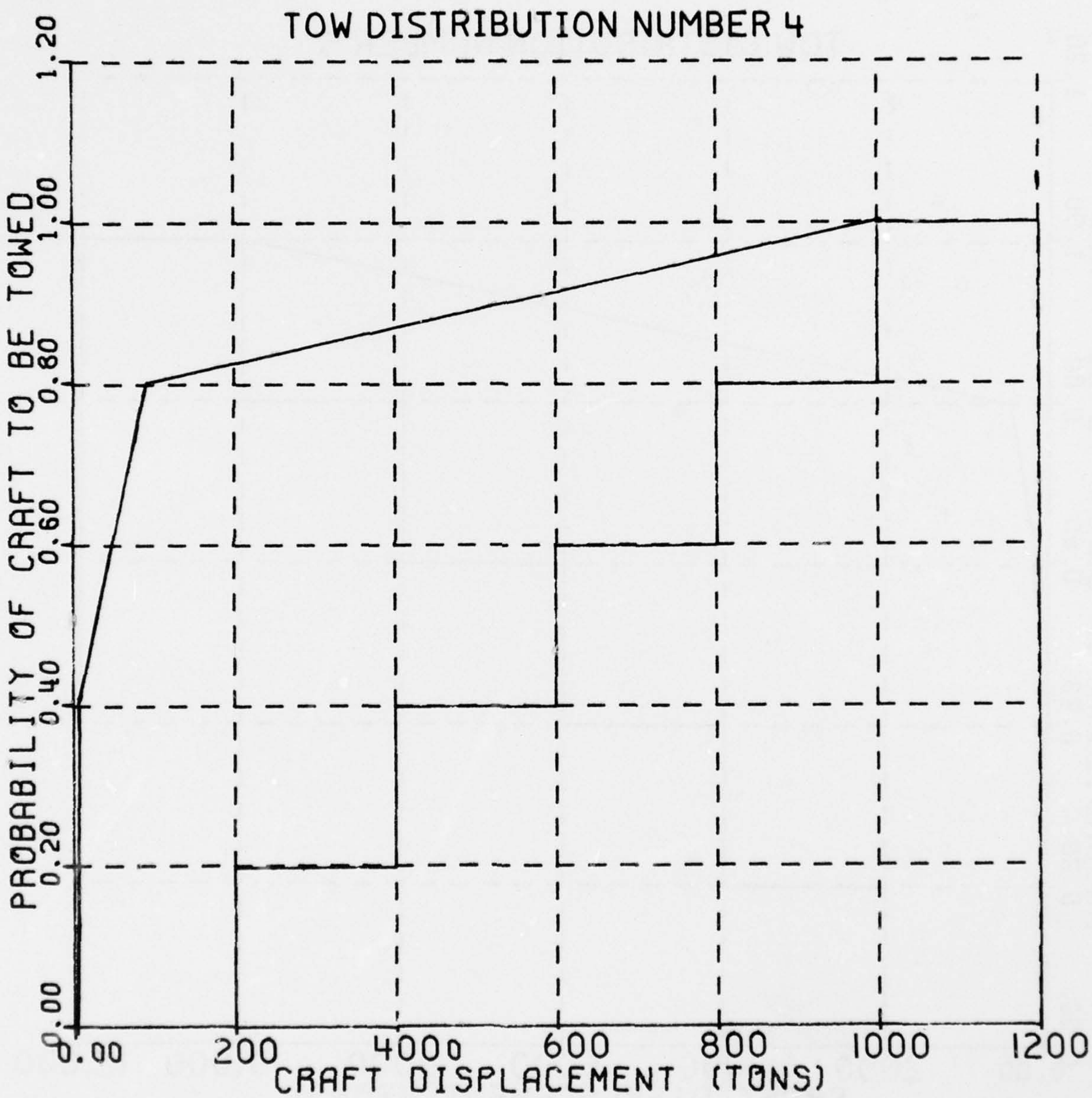


FIGURE E-4

TOW
CUMULATIVE PROBABILITY
-VS-
CRAFT DISPLACEMENT

TOW DISTRIBUTION NUMBER 5

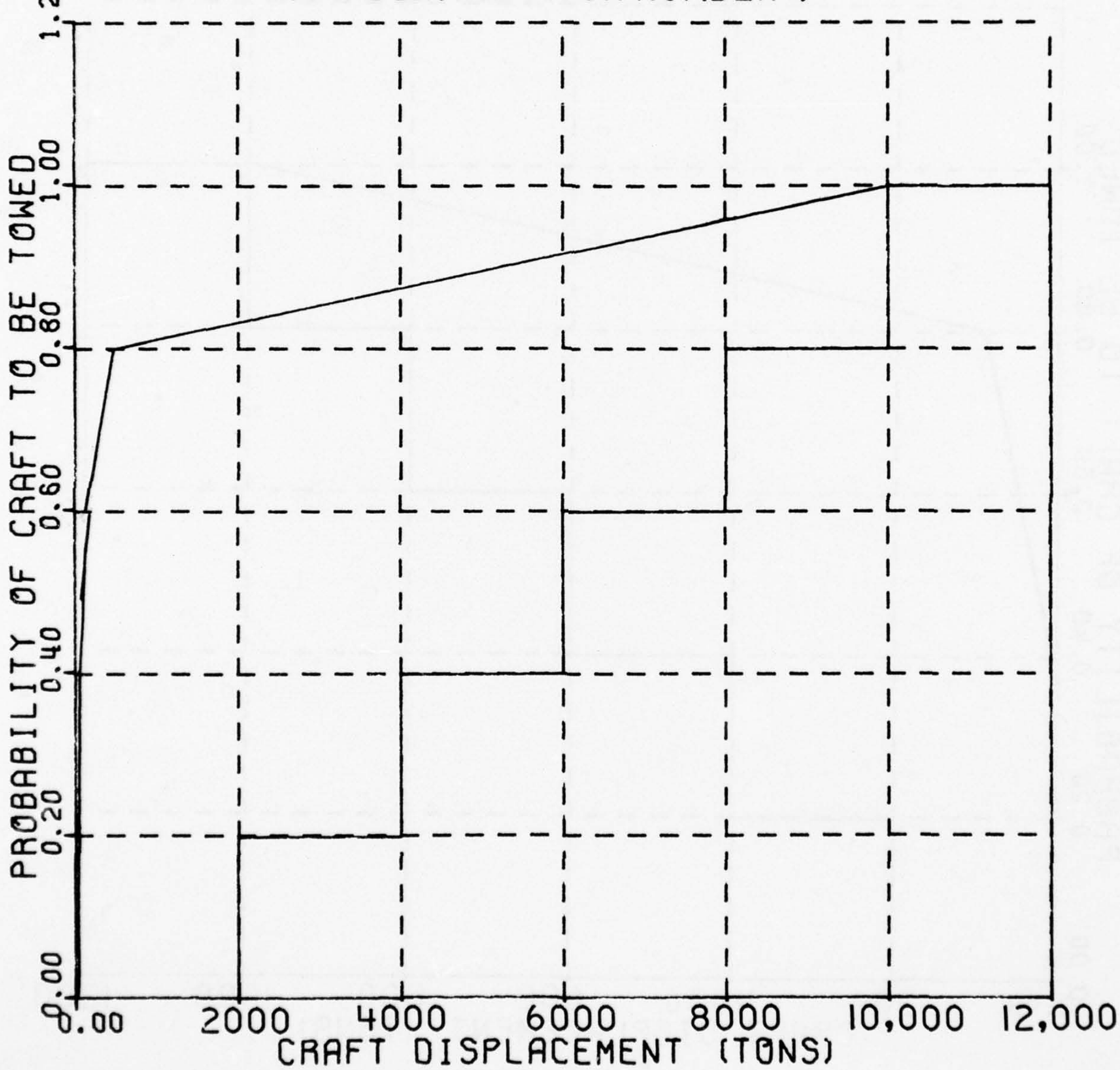


FIGURE E-5

TABLE F-1

EQUIPMENT INFORMATION LISTING

EQUIPMENT CHARACTERISTICS

INFORMATION ITEM / TYPE EQUIPMENT	WEIGHT (TONS)	DECK AREA (SQ. FT.)
TYPE 1 Harbor Oil Boom	0.11	50
TYPE 2 Coastal Oil Boom	0.36	60
TYPE 3 Fire Fighting Pump	1.34	50
TYPE 4 ADAPTS Pump System	2.23	120
TYPE 5 HSCOB Box/Boom	5.36	180
TYPE 6 HSCOB Retrieval	0.27	50
TYPE 7 Oil Recovery Device	7.14	700
TYPE 8 OCEANO Equipment	4.00	800
TYPE 9 WEATHER Equipment	9.00	1000

APPENDIX G

GLOSSARY AND LIST OF ABBREVIATIONS USED IN CREE MODEL REPORT

ACV - Air Cushion Vehicle

ANB - Aid to Navigation Boat

AVERAGE SORTIE - A sortie, consisting of parts of every task occurring in the scenario, obtained by weighing each sortie in the scenario by its probability of success and frequency of occurrence.

CALCOMP - California Computer (Graph Plotting Program)

CG - Coast Guard

CHAR - Craft Characteristics Computer Program

CREE MODEL - Cutter Resource Effectiveness Evaluation Model

DE - Diesel Engine

DECISION POINT PROBABILITIES - The probabilities chosen by the user at a branch point in the scenario

ELT - Enforcement of Laws and Treaties

FLOW CHART SCENARIO - A model of Coast Guard Program (scenario) in a flow chart format (like a wiring diagram)

FORCE MIX - The CREE Model does not address force mix analysis

FREQUENCY OF OCCURRENCE - The probability of occurrence (frequency is used to imply how often)

FUEL FRACTION - The fraction of useful load that is carried as fuel on board

FUNCTIONAL TASK GROUP - A group of tasks in a mini-flow chart (or module) that together model a particular activity (or function)

F_F - Fuel Fraction

G-OP - Operations Planning & Staff in Coast Guard Headquarters

GT - Gas Turbine

HPWC - High Performance Water Craft

IOCS - Input Output Computer Services (Incorporated)

LNG - Liquefied Natural Gas

MASTER TASK - A single task which models a class of similar actions by the Coast Guard vessel

MEP - Marine Environmental Protection

MLB - Motor Life Boat

MRB - Motor Rescue Boat

MSA - Marine Science Activities

OPERATIONAL ACTIVITIES - Missions or functions performed by CG personnel and units. The broad partitioning of activities when analyzing CG programs.

OPERATIONAL REQUIREMENTS - Those items that are necessary to fully describe the operational choices, environment and area of operation. Examples are decision point probabilities, sea state and distances to steam.

PARAM - Parameter section of the CREE Model Computer Program

PARAMETER - A multiplying factor (indicative of an effect such as sea state upon a task) which degrades the probability of success of that task.

PERCENT OF SCENARIO COMPLETED - The percent of all of the sorties in the scenario that the craft may complete without either running out of fuel or exceeding the time limit (sortie duration) for a sortie.

POD - Probability of Detection

PROBABILITY OF SUCCESS - The ratio of the number of times an event is performed successfully to the number of times it is attempted.

PROBABILITY OF SUCCESSFULLY COMPLETING SCENARIO - The average probability of success of every sortie in the scenario. (A way to visualize this "average probability of success" is to consider the case where every sortie has an individual probability of success of either 1.0 or 0.0. The fraction of the sorties in the scenario with 1.0 would represent the probability of successfully completing the scenario.)

PROBABILITY OF SUCCESSFUL OCCURRENCE (OF A SORTIE) - The product of the sortie frequency of occurrence and the sortie probability of success.

PROPOS - Program (CG) Probability of Success element of the CREE Model Computer Program.

PSS - Port Safety & Security

PWB - Port & Waterways Boat

P/L - Pressure to length ratio; used in describing Air Cushion Vehicles

RANGE FRACTION - The fraction of the craft's fuel capacity (which equates to range) that may be expended in an operation. The remainder is the fuel reserve which may not be expended in the scenario.

R&DC - Research and Development Center

SAR - Search and Rescue

SEA STATE DISTRIBUTION - The probability distribution of sea states in a given region over the extended time of operation.

SCENARIO - A sequencing or flow of events of an operation

SES - Surface Effect Ship

SORTIE - A sequence of tasks performed by a craft with a logical beginning and end; for example, a SAR case starting from the pier, continuing through the operation, and finally terminating at the pier.

SORTIE DURATION - The maximum allowable time for any sortie in a given scenario.

SS - Sea State

SWATH - Small Waterplane Area Twin Hull

SYSTEM - Not mentioned in the CREE Model reports

TASK - The lowest level of discrete activity such as a transit or tow in a Coast Guard Program.

TOWING DISTRIBUTION - The distribution of craft, according to length or displacement, to be towed in the region of operation.

TPOS - Task Probability of Success section of the CREE Model Computer Program.

TSC - Transportation Systems Center

UTB - Utility Boat

VISIBILITY DISTRIBUTION - The distribution of visibility in the region of operation.

WHEC - High Endurance Cutter

WMEC - Medium Endurance Cutter

WPB - Patrol Boat

Δ - Displacement

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